# Chemical Engineering

MARCH 24, 1958
Published every-other-Monday
Seventy five cents

new ga
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supplement
natural gas

page 121

WHICH GAS PROCESS WILL BE USED NEW HEAT CAPACITY RATIOS CHEMICAL ENGINEERS LOSE GROUND

PAGE TWO



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### MARCH 24, 1958

JOHN R. CALLAHAM, Editor-in-Chief

### Meet Our Midwest Editor

By the time you read this, CE's new Midwest Editor will be in Chicago covering developments in the area first-hand.

He is T. Peter Forbath (best known as Pete), a chemical engineering graduate (1953) of Brooklyn Poly and a seasoned CE editor.

Pete's sound engineering background, his varied industry experiences, his broad editorial training, his energy and personal interests, all made him our logical choice to represent CE in the Midwest. He replaces Frank Byrnes who left us in November, after seven years, to become a vice president of Mid-West Laboratories, Inc.

Pete's assignment is to follow, evaluate and report significant Midwest developments and trends of interest to CE's readers.

He will develop editorial material for all sections and departments of CE: Byline articles and reports, news of industry and technology, process flowsheets, new chemical products and process equipment, engineering kinks and shortcuts, data on corrosion and materials—and so on.

He'll also represent CE at meetings and conventions, press parties, plant tours and the like. As a chemical engineer, Pete plans to become active in Midwest AI-ChE and other engineering activities.

Pete will concentrate on the 11 states of Illinois, Ohio, Michigan, Indiana, Wisconsin, Missouri, Kansas, Minnesota, Iowa, Nebraska and Kentucky. Other CE editors will, of course, also visit these states regularly.

We hope you'll soon get to know Pete and to work with him in developing your editorial ideas. He invites you to contact him at 520 N. Michigan Ave., Chicago 11 (Mohawk 4-5800).



SIXTH OF TWENTY-SIX ISSUES

6/26

### GUIDED TOUR

### Which new processes will be used to supplement natural gas?

Why does the old standby—manufactured gas—play second fiddle today? What are the problems of peak loads in natural gas supply? How can manufactured gas be fitted to specific conditions of load and cost? Here's how chemical engineering ingenuity came to the rescue with some new and improved processes. (p. 121)

#### How to lower construction costs

Chemical engineers can design for lower construction costs when they know more about contracts, estimates, erection, specs. And they should. Here's a brush-up on some dollar-saving techniques. (p. 133)

### Five new heat-capacity-ratio charts

You'll be far more accurate if you use these brand new graphs. They're for the

## Chemical

GUIDED TOUR

five most common hydrocarbons. Their coverage of a wide range of temperature and pressure gives broadest usefulness. (p. 138)



### Easy way to watch yields and capacities

Simple device will help visualize and guide your operations. Easily made versatile chart visually relates raw materials, intermediates and products; spots bottlenecks; suggests future expansions. (p. 142)



### In this issue: A brand new series

First of a new series starts this month in your CE Refresher. It's basic material to help you with your mass transfer operations. We'll review—and sometimes introduce—the old and new concepts. (p. 145)



### Are chemical engineers losing ground?

We're graduating more ChE's, but not enough. This conclusion emerges from recent data. A career guidance counselor suggests a logical way to start attacking this growing problem. (p. 163)

CE is edited for the engineer concerned with chemical operations, whatever his function . . . administration, production and plant operations, design and construction, research and development, sales and purchasing. More engineers subscribe to CE than to any other magazine in the field. Print order this issue:

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nan. Assistant Editors: Frances Arne, John B. Bacon, T. Peter Forbath, Mary A. Gibbons. Editorial Assistant: Roland A. Labine. Economics Consultant: William H. Chartener.

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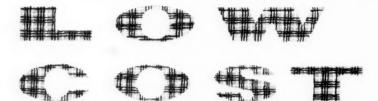
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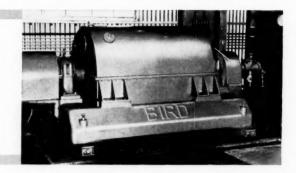
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## Chemical Engineering

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## Petrochemicals & Petroleum Refining

### MARCH 24, 1958

### Also of Basic Interest

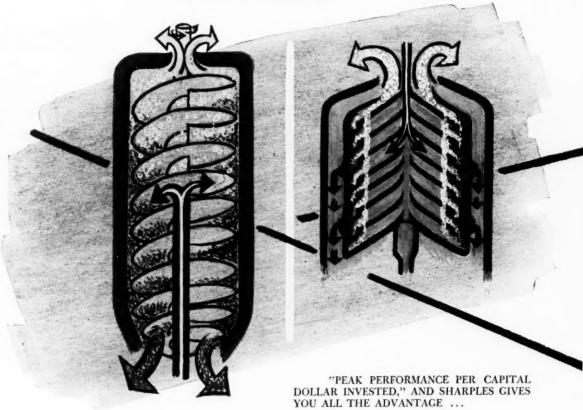
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up daily in most processing operations. Brush up now on

the fundamentals with this new Refresher series.

### The economics of solids dewatering... for 1958



With two new advanced design centrifuges for dewatering and clarification at high capacity, Sharples helps you make the best choice of the most productive, most economical investment. The DH-6 Nozljector has new built-in efficiencies never before achieved, plus tremendous capacity; and the P-7000 Vertical Super-D-Canter features important advantages of unique and timely value.

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Models available to operate at pressures to 150 psi.

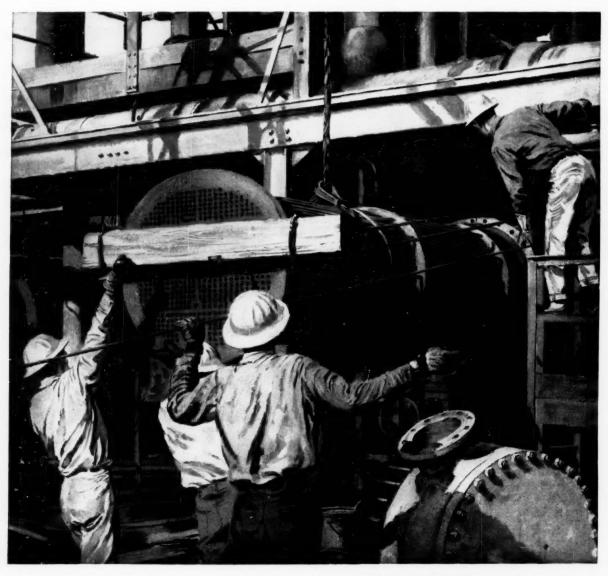
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March 24, 1958—CHEMICAL ENGINEERING





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You name the air conditions you want, and the chances are excellent that a flexible Kathabar system can deliver them to your benefit.

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## any humidity condition...

## for your process and comfort



## Using Salt Efficiently

by INTERNATIONAL SALT COMPANY, INC.



## "Lixator" Improvements Make Brine Production More Efficient

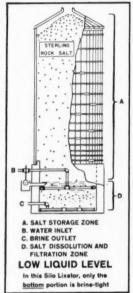
Widely used throughout industry, Lixators are automatic rock-salt dissolvers developed exclusively by International Salt Company. They produce high-quality, fully saturated, self-filtered brine... and virtually eliminate the work and expense of storing, handling and using dry salt.

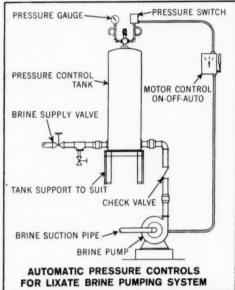
Excellent as this brine-making equipment is, International is constantly working to *improve* Lixator designs. From time to time, we also introduce special new Lixator attachments. Here are some improvements and attachments that can make production of Lixate brine more efficient and economical in your plant.

Low liquid level—a basic design feature that provides great savings by eliminating the need for deep salt-dissolving tanks. For example, it is possible to convert an old silo, dry-salt storage bin or unused room into a first-rate Storage or Silo Lixator simply by making the lowest portion into a waterproof salt-dissolving and brine-storage tank. The upper portion need not be waterproofed or made brine-tight.

A common method of waterproofing is to line the floor and bottom portion of the walls with concrete. Lixate brine is made in this lower tank portion, with dry salt occupying the space above the liquid level. **Electrode controls.** To regulate the liquid level in a Lixator, electrode controls are often used. This is an excellent alternative to the standard float controls in many Lixator installations.

Two electrodes of different length are protected in a length of pipe, then immersed in the Lixator. Whenever the liquid level falls below the lower electrode, the electric circuit is broken, a relay opens to close a load contact, and the water valve is opened. When the liquid level rises to the higher electrode, the circuit is closed, and the relay closes to shut the valve. In this way the brine level is maintained between the desired limits in the Lixator—continuously and automatically.





Pressure controls... for brine systems. International has introduced the technique of automatically starting and stopping Lixate brine pumps by pressure switches. If a valve is opened anywhere in the brine distribution piping, brine flows and brine line pressure drops slightly. This, in turn, activates a switch, starting the pump, which withdraws brine from the Lixator. Everything is automatic. The operator only opens and closes a brine valve at the point of use.



Introduction of brinemetering devices. In cooperation with leading meter manufacturers, International has pioneered in the application of

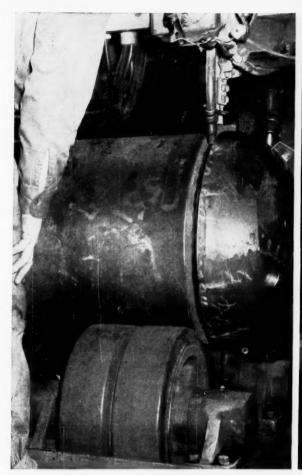
highly accurate and specialized meters for brine. Among the advantages of using these meters with Lixators is precise *salt* measurement, since every gallon of Lixate brine contains exactly 2.65 lbs. of salt. Also, automatic shut-off metering devices allow you to preset the amount of brine you want. Flow will stop when this amount has been measured out.

In many other ways, brine meters and other Lixator attachments can boost brine-making and brine-using efficiency. To find out how you can benefit from such devices, contact International. One of our experienced sales engineers will gladly explain about brine-density and brine-flow regulators, piping layouts, continuous brine-dilution devices, etc. He can also recommend the type and size of Sterling Salt best suited to your needs.

INTERNATIONAL SALT CO., SCRANTON, PA. Sales Offices: Atlanta, Ga.; Chicago, Ill.; New Orleans, La.; Baltimore, Md.; Boston, Mass.; Detroit, Mich.; St. Louis, Mo.; Newark, N. J.; Buffalo, N. Y.: New York, N. Y.; Cincinnati, O.; Cleveland, O.; Philadelphia, Pa.; Pittsburgh, Pa.; Memphis, Tenn.; and Richmond, Va.

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### Pipe fails after 9 months—hose goes 6 years

They hardly expected a materials handling problem at this Ohio boxmaking plant. After all, there's nothing very abrasive-looking about paper slurry. But the fact remained, it was eating through heavy steel pipe in a scant 9 months or less.

Here was a problem, they felt, for the G.T.M.—Goodyear Technical Man. And it was a job, as he saw it, for Diversipipe—the rugged, flexible rubber pipe designed to stand up to the roughest sort of abrasive use.

Result: the G.T.M.'s Diversipipe has now been on the job for 6 years—more than 8 times the longest pipe-life. And it's still in fine shape. If you're losing money down the pipe at your plant, call for the G.T.M. He can recommend from hundreds of types of hose-each designed to do a specific job better-and cheaper. Contact him through your Goodyear Distributor-or by writing:

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IT'S SMART TO DO BUSINESS with your Goodyear Distributor. He can give you fast, dependable service on Hose, V-Belts, Flat Belts and many other industrial rubber and nonrubber supplies. Look for him in the Yellow Pages under "Rubber Goods" or "Rubber Products."

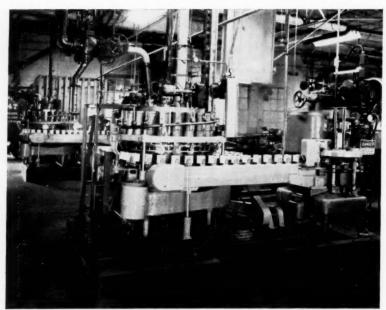
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## PFAUDLER



425 quarts a minute filled on this 21-station lube filler at Texaco plant. A total of three

Pfaudler fillers handle all lube packaging requirements of the Port Arthur plant.

## Filling without spilling at Texaco to 99.9969% accuracy

Texaco uses just three machines at its Port Arthur plant to fill a complete line of motor oils, hydromatic fluids, and antifreeze in quarts and gallons.

Two of these machines—RPL-21 type Pfaudler piston fillers—fill 410 to 425 quarts a minute. They each hold another 65 quarts a minute in reserve capacity. They fill at any

viscosity over the complete temperature range 80° to 105° F.

The third machine—an RPL-7 Pfaudler filler—handles gallons at 60 to 80 per minute.

All three machines are accurate to  $\pm 0.1$  ounce by liquid volume. They eliminate spillage completely . . . send cans from the plant with labels and cartons *clean*. No maintenance is required beyond routine cleaning.

There are only three primary wearing parts on these Pfaudler fillers: piston and valve rollers and valve trip cams. All are inexpensive and easy to replace. There are no connecting rods or wrist pins to cause trouble.

Simple, positive adjustments of the can support rails eliminate product spillage by compensating for the centrifugal forces generated during high-speed filling. An accelerating infeed screw pushes cans in uniformly without jamming. Cleaning is easy, too. You empty the bowl through a drain port, flush with kerosene, put the machine through a few revolutions, and it's clean.

There's more information about the complete line of Pfaudler fillers offered in the coupon.

### New flush valve boasts onepiece glassed head and stem

When we took all the porcelain out of this bottom outlet flush valve, we eliminated a major cause of valve failure.



Head and stem are one piece and glassed. No cement. The seat is made of rigidized Teflon-glass fiber and its bevel mates with that of the spherical head. Rubbing the glassed head on the Teflon seat produces absolutely no static. The Teflon also has some "give" so you can get a firm seating without danger of cracking the head covering, a continual problem with the old porcelain designs.

We don't have to tell you of the positive and leakproof sealing you

### CORROSIONEERING NEV

get with this ball-joint construction. And it's probably equally self-evident that the rounded, glassed head eliminates product build-up during processing.

So all there is left to tell is that the new design is interchangeable with existing valves you might now be using, and that the unit costs no more than a conventional stainless steel valve. Sizes range from 11/2 by 1 to 8 by 6 in six different models.

Anything else you might want to know is covered in Data Sheet 42 which is offered in the coupon.

This is the most glassed-steel agitated reactor you've seen in one piece. O.D.: 120 inches. Height: 125 inches, Capacity: 7000 gallons, Material: glassed steel. It will be used to process monochloroacetic acid and alcohol at 158° F. The jacket is designed to take a 25 psi pressure at 350° F. This vessel uses a conventional three-blade impeller without a foot bearing. The agitator is set only 10 inches off bottom. Moral: We are ready to answer the most unusual process equipment requirements, and to glass any vessel from one-gallon lab units to giants like this. For the record: We've made vessels up to 35,000 gallon capacity for large volume storage and these are glassed, too!





### 130th Technical Course on maintenance and repair completed

Since we started our program of instructing maintenance and process men in the care and repair of glassed steel, more than 1800 men from more than 250 companies have graduated cum laude. The program started in

An interesting fact proves that these men and their companies have benefited from the instruction. Last year there was more than twice as much glassed-steel equipment in the field as in 1945. Yet we had far fewer units returned for factory repairs.
A goodly share of this improve-

ment can be laid to the fact that

we have improved our glass over the years as well as the design of the equipment and accessories. But much of the improvement must still be attributed to more effective preventive maintenance in the field and to more effective repairs made right in customer plants by customer personnel.

If you have some new men you'd like to take the course. either here in Rochester or near your own plant, please let us know. You can start by writing for a copy of the program describing the course's subject matter.

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Company		

## Life on the Chemical Newsfront







QUICK DEATH to insect parasites on poultry, hogs, and nonmilking cattle will follow the U. S. Dept. of Agriculture's recent acceptance of Cyanamid's malathion for direct application. Called "one of the safest insecticides to handle," malathion provides effective control of lice on swine, and lice and ticks on cattle. It is specially valuable in louse control, where indications are that it kills eggs as well as adults, thus extending protection. The broad-spectrum killing power of malathion is particularly useful on poultry where lice, mites and ticks are simultaneously brought under control. (Phosphotes and Nitrogen Division)

NEW FREE-FLOWING PELLETS permit rubbermakers to handle the popular MBTS Accelerator with less dust and greater accuracy. The lumping and dusting typical of the powdered material are eliminated by these formed spherical pellets that pour freely and, shown on the right, are virtually dust-free. In the mixing operation, Cyanamid MBTS Pellets crush instantly and disperse uniformly. Pelletizing is the latest of several innovations made by Cyanamid's Rubber Chemicals Department toward producing a benzothiazyl disulfide accelerator with optimum handling and performance characteristics. (Organic Chemicals Division)

PUTTING A "BACKBONE" IN WATER is a recently developed role for N,N'-methylenebisacrylamide. Usedinconjunction with acrylic monomers, it forms stable gels in which the water content runs as high as 95%. Added to the monomers which give normally water-soluble polymers, N,N'-methylenebisacrylamide forms stiff gels impermeable to water due to its cross-linking action. The setting time of each gel can be controlled to range from several seconds to hours. A data sheet is available from Cyanamid.

(Market Development Department)





**STILL TOPS IN COLOR PERMANENCE** are the Vat Dyes used for cottons, washable rayons and linens. Fixed for the life of these textile fibers, Vat Dyes withstand all the sun, wear and washing that the fabric itself can tolerate. Cyanamid Vat Dyes are available in an ever-widening color range, each conforming to the rigid industry standards endorsed by the Vat Dye Institute to which Cyanamid belongs. Buyers are assured of this high-quality performance when garment tags bear the statement "Guaranteed Vat Color." (Organic Chemicols Division)





REDUCING RAW MATERIAL AND PROCESSING COSTS are some of the benefits obtained through the use of Cyouest 40\* sequestering agent. Producers and purchasers of raw materials can use this remarkable sequesterant to maintain high-quality standards while avoiding costly purification steps to remove metal ions that spoil color, cause turbidity and catalyze degradation reactions. Cyouest 40 ties up troublesome metal ion impurities in raw materials, eliminating their detrimental effect on processes and products.

(Industrial Chemicals Division)

CYANAMID

AMERICAN CYANAMID COMPANY
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

For further information on these and other chemicals, call, write or wire American Cyanamid Company



#### Needle Valves

Rugged, outstanding performers for proportional control of small flows. Interchangeable seat rings and plugs. For water, gas, steam, chemicals. Trim and body materials available for 'difficult' fluids. Shown here with unique reversible Stabilflo Motor.



### **Butterfly Valves**

Light and heavy duty types,
with angle or swing-through
seating, in spool or wafer
body style, for low pressure air,
gases in combustion control,
steam, high pressure gases and
liquids, etc. Available with
Stabilflo Motor (shown) or
cylinder operator.



### Super-Pressure Valves

For throttling or let-down service up to 30,000 psi. Features an exclusive high-pressure bellows seal. Port sizes and connections to meet high pressure process specifications.

### **GET THE BEST**



### Saunders Type Valves

A complete line, particularly suited to handling of highly corrosive fluids, or fluids containing solids in suspension. Available with Stabilflo Motor as shown, or with Stabiload Cylinder and Power Positioner.

### Gate Valves

Guillotine-type slide valves, specially designed to handle pulp fibre, slurries, and similar fluids. Available with Stabiload Cylinder and Power Positioner as illustrated, for throttling service, or with 4-way pilot valve for on-off service.



FOXBORO CONTROL VALVES

### SOLUTION TO YOUR CONTROL VALVE PROBLEMS

### QUICK REVERSIBLE FULLY ENCLOSED MOTOR WITH TAMPER-PROOF SUSPENDED SPRING CONSTRUCTION NO GUIDES NEEDED WEATHER-PROOF MOTOR HAS LOW CENTER OF AIR CONNECTIONS GRAVITY TRAVEL INDICATOR ACCESSIBLE STUFFING BOX TEFLON V-RING PACKING GUIDED PLUG WIDE RANGE EQUAL STABILFLO PLUG

GUIDED

## ...with Foxboro Pneumatic Control Valves

You can always be sure of getting the control valve best suited to flow conditions and control actions when you specify Foxboro. No other single source offers such a wide variety of control valves for specific applications. None other has Foxboro's experience in applying them — in every phase of industrial processing.

Your choice extends from valves for simple on-off control at one extreme, to specialized proportioning control at the other; for high vacuum work to operation at 30,000 psi; for temperatures from —350° to +1000°F. And there's a wide choice of plug designs —and of alloys and trim to handle even severely corrosive and erosive fluids.

You can save shipping cost and time, too, buying direct from Foxboro's strategically located branch shops. They're staffed by experts.

A few typical control valves from Foxboro's complete line are illustrated here. For full details, or specific information on your problem, call your nearby Foxboro Field Engineer or write The Foxboro Company, 363 Neponset Ave., Foxboro, Mass,

### STABILFLO CONTROL VALVES

For the great majority of temperature, pressure, flow, and liquid level control applications, this basic valve provides unsurpassed sensitivity and troubletree operation. Unique design features:

- Spring-above-diaphragm construction makes diaphragm motor self-aligning, virtually free from friction and hysteresis.
- Totally enclosed spring protects against tampering and corresion.
- High-lift wide range V-port provides greater increment of lift for given change in air pressure.
- 50 to I rangeability equal percentage characteristics.

## The Year Advertising Helped

N 1954 we had a business recession in the United States. Sales fell about 4% during the year. If management had followed the historic pattern of business ups and downs, advertising volume would have fallen much further.

But in 1954 the volume of advertising did not fall. It increased over 5%, and expenditures in all major advertising media rose. Every effort was made to stimulate sales when sales were needed to sustain prosperity.

This was something entirely new under the sun. It had a powerful influence in making the recession of 1953-54 one of the mildest on record. It helped greatly to speed business on to the record-breaking levels it attained in the years 1955-57.

There are several reasons why America's business management attacked this decline in sales with more advertising. One of them grew out of the greatly strengthened position of the American consuming market. Consumers' income after taxes has been rising an average of over \$10 billion a year since 1946, and this rising income is more widely distributed than ever before. Furthermore, consumers had piled up reserves of about \$200 billion in cash or its equivalent. These reserves offered a new and powerful inducement to increased selling and advertising effort even in the face of a possible decline in consumer income. (At the end of 1957, consumer reserves were \$225 billion.)

### Taking the Longer View

However, the principal reason why a sales decline was attacked

This editorial message was first published by McGraw-Hill two years ago. It describes advertising's dramatic contribution to the American economy during 1954. The theme of the editorial—that advertising can help promote economic stability by stimulating sales at a crucial time—is even more pertinent today.

As our economy grows, it is constantly changing. The conditions business faces today are not the same in every respect as those it faced in 1954. But business again has the opportunity, through advertising and other selling efforts, to help sustain a high level of economic activity. At the same time, it will be building markets for the period of renewed expansion that is sure to follow.

This editorial is reprinted exactly as it appeared in 1956 except for minor editorial changes to bring it up to date. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

Donald CMcGraw

PRESIDENT

McGraw-Hill Publishing Company, Inc.

with increased advertising is management's new-found conviction that good advertising is essentially an investment in the development of a market. Successful development requires sustained investment. The inclination of business management to take this longer view is, of course, motivated

## McGraw-Hill PUBLISHING COMPANY,



## Kill a Business Recession

by the fact that the American market, with over 3 million consumers being added annually, is growing at a prodigious rate.

Ten years ago only a handful of companies had plans for investment in new producing facilities extending beyond the current year. Today almost all leading companies have investment programs running some years ahead. And keeping pace with these long-range investment plans has been the development of sales and advertising programs to reach tomorrow's greatly expanded markets.

### Advertising's Key Role

This crucial role of advertising in providing driving power for our economy is gaining greater recognition every day. In his book, "People of Plenty," Professor David M. Potter of Yale University remarked: "Advertising is not badly needed in an economy of scarcity, because total demand is usually equal to or in excess of total supply, and every producer can normally sell as much as he produces. It is when potential supply outstrips demand—that is, when abundance prevails—that advertising begins to fulfill a really essential economic function."

Today abundance so completely prevails in the United States that it has been conservatively estimated that as much as a third of everything offered for sale falls in the realm of "optional consumption." That is, consumers can "take it or leave it" without any immediate personal inconvenience. But if they decide to "leave it," a terrific

economic depression will not be far behind. In such circumstances, advertising—in which, in all of its forms, we are now investing over \$10 billion annually—clearly is of crucial importance to our continued prosperity.

In performing its key role in past years, American advertising never realized its full potential. It successfully promoted sales. But it never was called upon to promote an overall economic stability as a direct outgrowth of increased sales.

By successfully promoting both sales and economic stability, as it did in 1954, advertising surely has added new strength to the American economy. It has also added a great new and constructive dimension to advertising itself.

One of the surest means of expanding your sales volume in today's industrial markets is through dominant advertising in the publications directly serving your major customers and prospects.

McGraw-Hill's business and technical publications can give you quick access to the men who initiate, specify and approve the purchases of industrial products and services. Because all are leaders in their respective fields, you are assured a maximum return on your advertising investment when you *concentrate* in the McGraw-Hill publications serving your most important markets.

INCORPORATED · 330 West 42nd St., New York 36, N. Y.

BUSINESS INFORMATION





## Results of 133-day Plant Corrosion Tests in a Continuous Process for the Distillation and Rectification of Crude CCI<sub>4</sub>

#### TEST 1

Suspended in vapor stream above top plate of bubble cap rectification column. Approximate analysis of vapor:

Carbon Tetrachloride . 99.398% Sulfur Chloride . . . . 0.600% Carbon Bisulfide . . . 0.002% Temperature: 78°C. (171°F.)

#### TEST 2

Suspended in reboiler for column, completely immersed in liquid with following approximate analysis:

Sulfur Chloride..... 98.30% Carbon Tetrachloride. 0.13% Iron as FeCl<sub>3</sub>...... 0.01% Temperature: 138°C. (280°F.)

CORROSION RATE		ATE
	TEST 1	TEST 2
Monel	†	†
Nickel	†	+
Inconel	†	+
Ni-Resist (Type 5)	†	0.001
Ni-Resist (Type 1)	<b>†</b>	0.002
Mild Steel	0.008	0.217
Cast Iron	0.007	0.128

\*\*inches penetration per year †less than 0.001

### Maintenance cost cut 90% in CCI4 system

Using Nickel alloys selected from in-plant tests, Westvaco runs column and reboiler 12 years. Savings exceed \$108,000

At Westvaco Chlor-Alkali Division of Food Machinery and Chemical Corp., corrosion by sulfur chloride had been causing failure of the bottom head of the reboiler in the CC14 system every 15 months. Other parts, too, had to be replaced frequently . . . running maintenance costs up to \$10,000 per year and more.

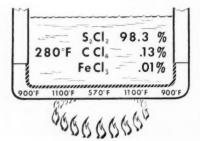
In 1944, engineers tested various materials in four critical environments in the system. The data showed that several nickel alloys provided superior corrosion resistance. And the system was redesigned using these alloys. In the 12 years since, there have been no replacements of major units. Yearly maintenance has stayed below \$1000.

#### Reboiler bottom head

This item, originally 11/2-inch cast

iron, is now 1-inch 10% Inconel-clad steel made by Lukens Steel Co. with fire-box steel backing.

The Inconel\* nickel-chromium alloy has high resistance to chlorinated organic solvents and also resists sulfidation at the high temperatures present. Sketch shows conditions.



### Vapor, return and drop lines

These lines are all Monel\* nickel-copper alloy.

Monel alloy provides protection against the small amounts of diluted hydrochloric acid likely to form by hydrolysis in these cool parts of the system.

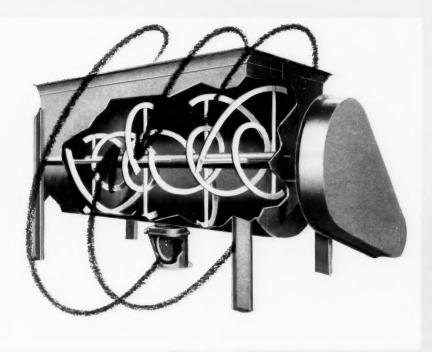
Ni-Resist\* high nickel cast iron completed the redesign. It was used for sides and top of the reboiler and for bubble caps, trays, and bottom sections of the still shell, which had originally been designed for cast construction.

Is your maintenance cost too high? Is corrosion or high temperature the likely cause? Inco's Development and Research Section can help you pin down the facts and select corrective alloys.

\*Registered trademark\*

The International Nickel Company, Inc. 67 Wall Street New York 5, N. Y.

### INCO NICKEL ALLOYS



### counterflow is key . . .

to rapid, thorough mixing in

## READCO Spiral Ribbon Mixers

You'll cut processing time, increase mixing efficiency with Readco Spiral Ribbon Mixers

Counterflow action of ribbon agitators accounts for thorough, highspeed blending, assures equal mixing throughout the entire volume.

Designed for batch or continuous mixing or blending of pulverized, granular, dry or wet materials, these mixers are supplied for operation under pressure or vacuum, with or without temperature controlling jackets.

Heavy-duty construction of carbon or stainless steel permits efficient service under long runs and rugged operating conditions. Working capacities range from 1 to 650 cubic feet.

For more information see Chemical Engineering Catalog pages 1483 to  $1490\ldots$  or write direct.



Whatever the mixing job: a READCO mixer!

READ STANDARD

York, Pennsylvania

A Division of Capitol Products Corporation



quench a big thirst-



"Fill it up!" and nearly 60 million automobiles take an annual 56 billion gallon drink. Helping to "set 'em up again" for aircraft, automobiles, L-P gas and diesel engines, virtually every type transportation, is the Peerless Hydro-Line® vertical pump. Available in two basic types, process and transfer, the Peerless Hydro-Line is serving in the handling of hydrocarbons such as gasoline, butane, propane, hot oils, etc.; hot or cold water; mild acids, basic and salt solutions. This flexibility of application, plus its space-saving vertical design, its outstanding NPSH (net positive suction head) characteristics and its ready adaptability to future system requirements, has made the Peerless Hydro-Line truly one of America's most versatile pumps. For complete information on the Peerless Hydro-Line vertical pump line, write for Bulletin No. B-1700.



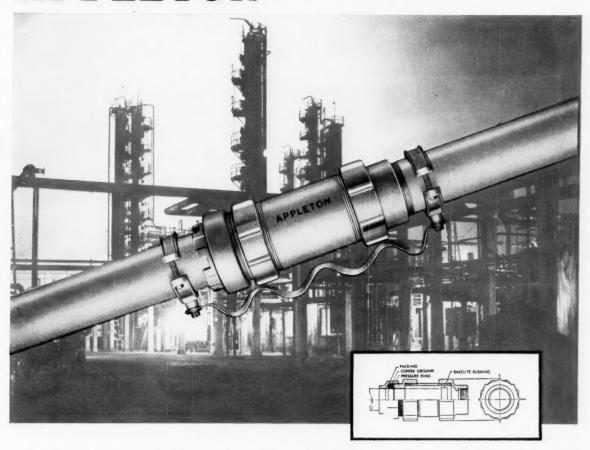
Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION

**Peerless Pump Division** 

Plants: LOS ANGELES 31, CALIFORNIA and INDIANAPOLIS 8, INDIANA
Offices: New York; Atlanta; St. Louis; Phoenix; San Francisco; Chicago; Fresno; Los Angeles; Plainview
and Lubbock, Texas; Albuquerque. Distributors in Principal Cities. Consult your telephone directory.

## APPLETON "XJ" Conduit Expansion Joints



### Relieve the strain of expansion and contraction on long runs of rigid conduit

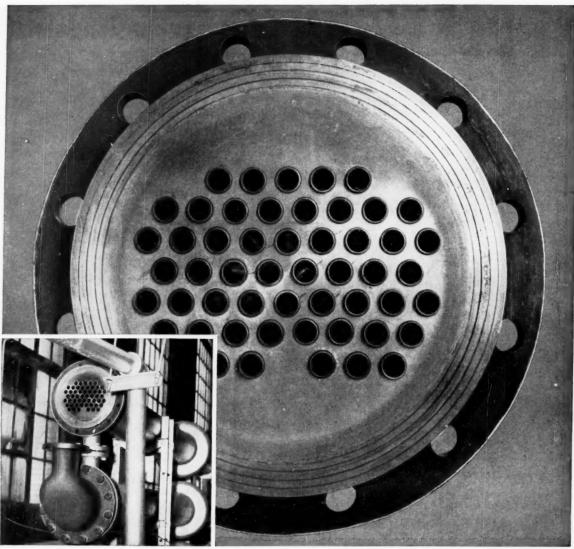
Temperature changes place a terrific strain on all long conduit runs. To relieve this potentially dangerous condition, it is best to install APPLETON "XJ" Expansion Joints at frequent intervals along the entire system. These weatherproof joints, for use with heavywall conduit, have a metallic packing and a bonding jumper to assure the entire conduit system remains a continuous electrical conductor. The jumper, installed in accordance with U. L. recommendations, gives double protection against extreme expansion movement reducing the effectiveness of the metallic bond.

As the conduit is inserted in the joint, a bushing is placed on the end in the manner shown. This bushing permits maximum conduit movement and yet the conduit can never pull free of the joint. The APPLE-TON "XJ" Conduit Expansion Joint features a metallic packing and pressure ring at the flexible end to keep the joint weatherproof at all times.

Wherever a long run conduit installation exists, the need for APPLETON "XJ" Expansion Joints exists. Interior or exterior, from Texas to Maine, temperature strains do exist, so take advantage of APPLETON'S product research program to give you the precision products you require . . . APPLETON "XJ" Weatherproof Expansion Joints for all long run conduit installations.

Sold Through Franchised Wholesalers Only





## Carpenter 7Mo Stainless Tubing

## No corrosion...no pitting after 4 years of handling hot SO<sub>2</sub> gases and vapors

 $\bullet$  The smooth, clean surfaces of the Carpenter 7Mo Stainless tubing in this 3-pass Relief Gas Cooler tell the whole story. Still like new after 4 years of carrying 8% SO2 gases and vapors from the top of a sulphite digester at temperatures in excess of  $200^{\circ}F.$  No maintenance. No replacement worries. No costly downtime.

If you have a tough corrosion problem involving stress corrosion cracking and pitting, see what Carpenter 7Mo Stainless Tubing and Pipe can do to solve it for good. Call your Carpenter Distributor for service that satisfies.



### BRIEFS for buyers of

Caustic Potash Sodium Sulfide and Sulfhydrate Oxalic Acid Benzoic Acid Phosphoric Anhydride

### Wet or dry How do you like your KOH?

If you're one of the relatively few peowho prefer caustic potash in the solid state, we can provide you with any of these seven forms, all at 90%

- 1. Solid
- 4. Walnut
- 2. Flake
- 5. Broken
- 3. Granular
- 6. Powder

7. Crushed

If one of these won't do, we can ship you 85%-strength KOH of even higher purity, in *flake* or *solid* form.

If you prefer your caustic potash liquid (it's generally cheaper and easier to handle), you can get it from us in concentrations between 45% and 52%, delivered in 55-gallon drums, tank cars of 4,000-, 6,000-, 8,000-, or 10,000-gallon capacity—or in duplex tank cars holding 3,000 gallons per compartment.

Is all this fuss worth while over a specialty alkali like caustic potash?

Well, our customers tell us it is. And they buy, under the NIALK® label, about half the caustic potash sold in this country.

We hope you'll think so, too.

### Sulfides in new drum easier to empty or re-use in your plant



Your operators will like the conven-ience of this new 400-lb. drum in which you can now purchase Hooker sodium

sulfide and sodium sulfhydrate.

The opening is 18 inches in diameter

-four inches wider and 65% larger in area than the former container.

This drum is much easier to empty with a scoop or shovel. It saves time and is safer when pouring, too. Flakes don't pile up around the opening when drum is inverted.

You'll also like the way this drum safeguards the exceptionally low iron content of our sulfide or sulfhydrate

until you're ready to use it.
Only brand-new drums are shipped;
none are re-used. A lacquer lining prevents iron pickup during shipping and
storage. Six lugs hold the lid on tight, and let you reseal the drum to protect any unused product.

There's no increase in price for the new drum. To get its extra convenience and safety, just specify Hooker sodium sulfide or sodium sulfhydrate on your next order

### Oxalic acid in two crystal sizes

The distributor who keeps you supplied with Hooker chemicals can serve you even better now, if you're buying oxalic acid in l.c.l. quantities

He has, or can quickly get for you, OLDBURY® oxalic acid assaying 99.8% minimum.

It comes in two pure white crystal sizes, No. 2 fine and No. 3 fine, packed in 100-lb. and 300-lb. Leverpak con-

When you order, specify high quality OLDBURY oxalic acid from your Hooker distributor. Meanwhile, a check on the coupon will bring you specifications, typical analysis, particle size, and other

### Benzoic acid in new crystal form

Customers told us there were three ways to improve benzoic acid. Make it dissolve faster. Make it freer flowing. Get rid of irritating fines.

We've done all three with a new Crystal Benzoic Acid. Both the crystals and a powdered

form are available in two grades. U.S.P. grade assays 99.3% min.; technical grade is 98.0% pure. Both grades have 0.2% max. water content.

Check the coupon for more data on benzoic acid and its chemical cousin, sodium benzoate, which we also supply in U.S.P. and technical grades.

### What do you want to dehydrate?

If you have a drying problem, don't overlook phosphoric anhydride, P<sub>2</sub>O<sub>5</sub>. This OLDBURY product is one of the strongest known desiccants.

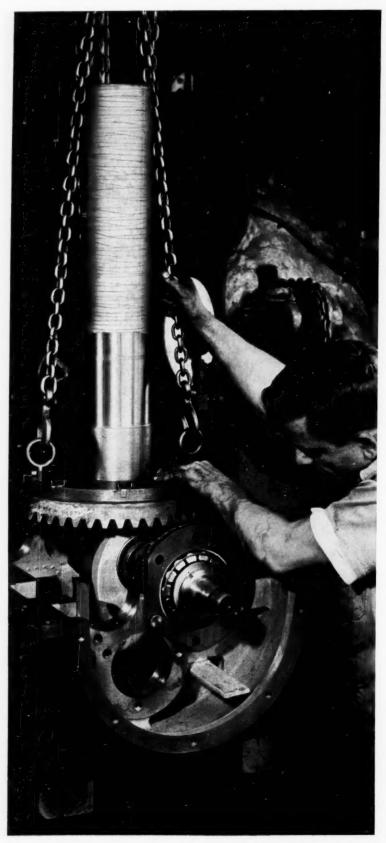
A white fluffy powder assaying 98% min. P<sub>2</sub>O<sub>5</sub>, it contains no sulfate. This is an important advantage in one of its major uses-as a condensing agent in making clear methacrylate resins.

If you're interested in phosphoric anhydride for a present or a potential use, just check the coupon for more complete information.

Caustic Potash	☐ Benzoic Acid
□ Sodium Sulfide	☐ Sodium Benzoate
Sodium Sulfhydrate	☐ Phosphoric Anhydride
Oxalic Acid	☐ New list of products— Bulletin 100-A
Clip and mail to us with you requesting samples, please use	r name, title, and company address. (When business letterhead.)

Niagara Falls Tacoma Montague, Mich. New York Chicago Los Angeles Philadelphia Worcester, Mass. In Canada: Hooker Chemicals Limited, North Vancouver, B. C.





## YOU GET MORE FOR YOUR FLUID MIXER DOLLAR

### because we design and build the whole unit

It's simple economics! Philadelphia Mixer is the *only* manufacturer that designs and builds the complete unit—mixer drive, shafting, impeller and coupling. Because *we* control production and costs, we can *afford* to give you more mixer per dollar. For example:

- Extra large, heavy duty bearings throughout.
- Extremely heavy output shafting machined, ground and polished.
- Drives designed with extra strength and rigidity to take maximum thrust and unbalanced loads.
- Quick-change gear sets for 14 standard speeds.

You don't pay a premium price for these extras—or for the better performance, longer life, lower maintenance. You get them as a *bonus* when you buy from Philadelphia Mixer... the only source that maintains completely integrated facilities for mixer design, application engineering, manufacturing and field service.

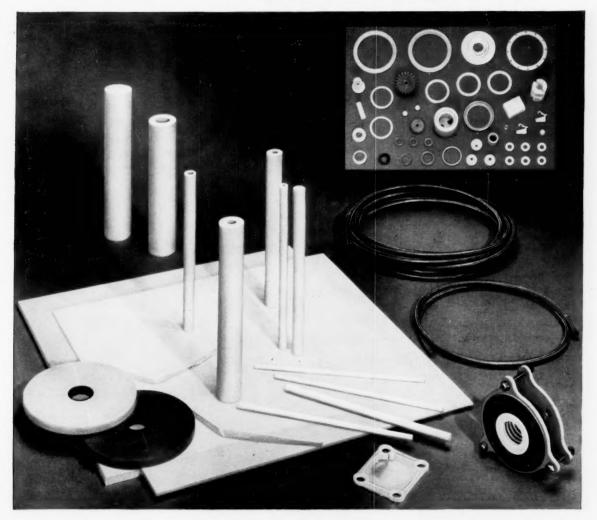
You can select your Philadelphia Mixer from six standard models. One to 200 hp. Special units available to 500 hp. Horizontal or vertical motor. Mechanical seal or packed stuffing box. Paddle or turbine type impellers. If you have had no direct experience with Philadelphia Mixers, we urge you to consult those who have. We'll be glad to help you.

Get the full story on Philadelphia Mixers. Write for Catalog A-27. It contains complete mechanical design information that permits you to make a catalog selection of the unit that best suits your requirements. Philadelphia Gear Works, Erie Ave. and G Street, Philadelphia 34, Pa.

### philadelphia mixers

Offices in Principal Cities

## If you need TEFLON\* in <u>any</u> form R/M is the place to get it!



Raybestos-Manhattan pioneered in research and development in the use of "Teflon." R/M has had vast experience in fabricating this amazing substance . . . has accomplished things with it once thought impossible, such as molding highly complex valve diaphragms.

But R/M has more than the know-how—it has the facilities to produce "Teflon" in exactly the form you want it . . . can supply all your needs, from the usual types of

tubes, tape, rods, sheets and flexible wire braid covered hose to complicated molded and machined parts.

That is why R/M should be your headquarters for all your needs in products made of "Teflon," from simple standardized parts to intricate components painstakingly customized to your specifications. Call on your nearest R/M district office for the cooperation you need. Or write for detailed information.

A Du Pont trademark



### RAYBESTOS-MANHATTAN, INC.

PLASTIC PRODUCTS DIVISION FACTORIES: MANHEIM, PA.; PARAMOUNT, CALIF.

Contact your nearest R/M district office listed below for more information or write to Plastic Products Division, Raybestos-Manhattan, Inc., Manheim, Pa.

BIRMINGHAM 1 • CHICAGO 31 • CLEVELAND 16 • DALLAS 26 • DENVER 16 • DETROIT 2 • HOUSTON 1 • LOS ANGELES 58 • MINNEAPOLIS 16

NEW ORLEANS 17 • PASSAIC • PHILADELPHIA 3 • PITTSBURGH 22 • SAN FRANCISCO 5 • SEATTLE 4 • PETERBOROUGH, ONTARIO, CANADA

RAYBESTOS-MANHATTAN, INC., Engineered Plastics • Asbestos Textiles • Mechanical Packings • Industrial Rubber • Sintered Metal Products • Rubber Covered Equipment Abrasive and Diamond Wheels • Brake Linings • Brake Blocks • Clutch Facings • Laundry Pads and Covers • Industrial Adhesives • Bowling Balls

CHEMICAL ENGINEERING—March 24, 1958



## Undisputed First Choice

with engineers who have had occasion to thoroughly test this type of filter. Shown here are structural features that are the result of over 30 years experience in building this one filter. If it could be made better or cheaper Sparkler would have made it that way long ago.



Aloysius C. Kracklauer Originator of the Horizontal Plate Filter

A.S.M.E. designed construction is standard for pressures up to 60 lbs. on all filter tanks,

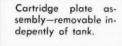
Plates sealed independently at center and periphery to assure positive seal.

Plates sealed independent of tank closure to secure a positive seal for both filter plates and for tank cover.

Scavenger plate supported by re-inforced flat bottom tank.

SPARKLER

FILTERS

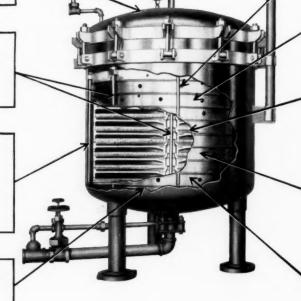


Heavy solid plate rings precision machined.

Heavy perforated sheet metal support for filter paper.

A more positive filter seal is obtained when hydraulic pressure is applied to plates externally rather than internally.

Plate designed to reduce flow friction to a minimum.

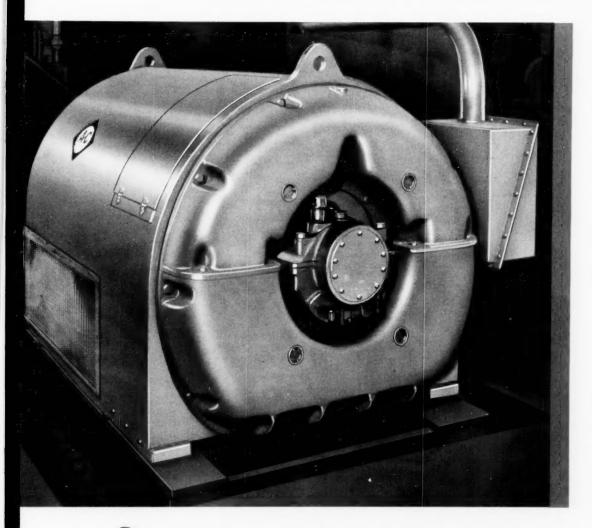


The Sparkler, original exclusive horizontal plate design and flow principle, has never been equalled for efficiency and dependability in filtering with any and all types of filter aids. The cake maintains its original position as formed regardless of pressure fluctuation flow rate or viscosity. No break-through is possible, even with a complete shut down of the filter. Filtering can be resumed with perfect safety at any time. With Sparkler plate construction a completely sanitary filter can be furnished.

SPARKLER MANUFACTURING CO. MUNDELEIN, ILLINOIS
Sparkler International Ltd.—Manufacturing plants in Canada, Holland, Italy and Australia.
REPRESENTATIVES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

## Revolutionary Advance in Motor Protection

made possible by SILCO-FLEX insulation
plus 10 integrated mechanical features

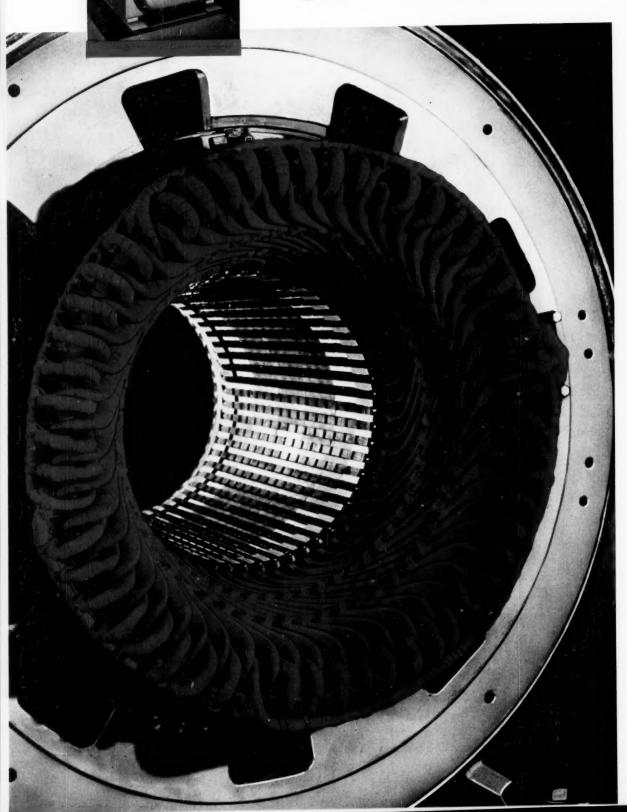


Designed to meet needs of chemical, paper, petroleum, metals, power and rock products industries where moisture, dirt, abrasive dusts or corrosive atmospheres are a problem.

**ALLIS-CHALMERS** 



## New Motor is



# super-sealed

# It's drip-proof — yet withstands moisture • abrasive dust • chemicals • high humidity • heat

The *Silco-Flex* system of insulation is used on all stators. Field coils of synchronous motors are bonded in heat-stabilized resins, enclosed in a resin-impregnated sheath of oriented glass fibers and bond-locked on the pole structure.

The superior electrical protection of Super-Sealed motors results from the insulating *system* used...not just the insulating material. The same material, conventionally applied, would retain certain weaknesses of conventional insulation.

# Applied the A-C way, it has these qualities that add reliability and service life:

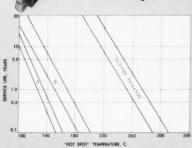
Dimensionally stable — withstands heating, thermal shock, vibration and fatigue at elevated temperatures.

Sealed throughout resistant to most chemicals, water, high humidity, weather, aging, corona and lubricants.

All Super-

Homogeneous — provides a void-free dielectric barrier, homogeneous under extremes of differential expansion and contraction due to thermal cycling.

# All Super-Sealed motors have revolutionary Silco-Flex insulation



**Heat resistant** — Silco-Flex insulation gives much longer service life under higher temperatures than conventional materials.



Silco-Flex

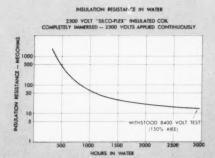


Polyester

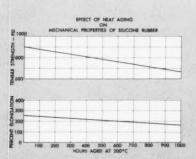


Asphaltum Mica Tape

Abrasion resistant — Samples of insulation show effect after sandblasting for one minute with 90-grit aluminum oxide and 100-psi air. Nozzle to sample distance was six inches, thickness equivalent to 2300-volt insulation. Note difference in abrasion.



Moisture resistant — Test curve shows that Silco-Flex insulation, after 3000 hours of total immersion with 2300 volts impressed on coil, withstood high potential test of 8400 volts without injury.



Flexible, resilient — Rubbery Silco-Flex insulation remains flexible and resistant indefinitely. It is especially resistant to mechanical abuse and to stresses of overloading, rapid starting and stopping.





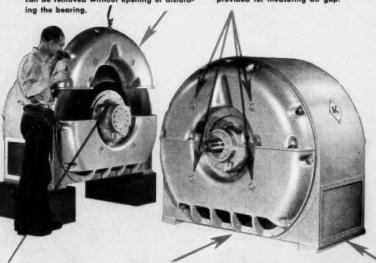
# New Super-Sealed motors

# 10 mechanical features

Super-Sealed motors combine the perfect insulation with features that assure the mechanical as well as the electrical reliability of these motors.

Accessibility — Split-type end shields can be removed without opening or disturbing the beggins

Ease of Inspection — Four points are provided for measuring air gap.

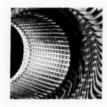


Clean Check — Glass inspection bullseye permits checking operation of oil rings without dirt falling inside bearing. Full Circle of Protection — Steel plate across bottom of motor protects it from dirt and rodents.

Clean Appearance — Foundation bolts are hidden, machine is clean-looking.



Self-Aligning Capsule-Type Bearings are center seated with single seat. Breather relieves pressure of oil in bearings that could cause leakage.



Precision Construction—
Slot sticks are non-hygroscopictrapezoidal, fabric base phenolic.
End turns, spaced with polyester
glass mat spacer pieces, are laced
and tied with flat lubricated glass
tubing for long trouble-free life.



Solid Construction—Silverbrazing rotor rods to end ring assures a good joint.



**Rigid** — End turns of higher speed motors are supported by insulated coil support rings to prevent injurious distortion due to high starting torque and frequent starting.

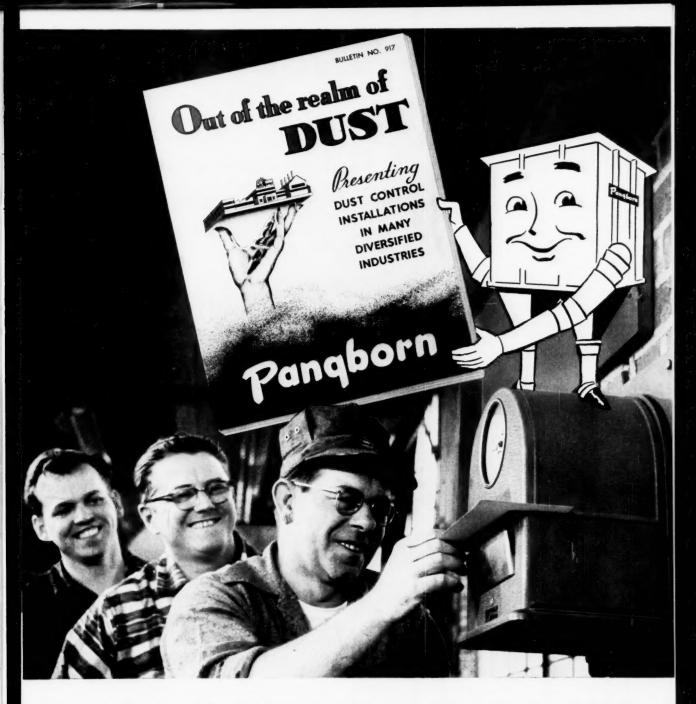


Timesavers—Separate plates provided to show direction of rotation and magnetic center. Terminal box is amply sized and diagonally split. Leads are brought out through grommet.

For the complete story, call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

**ALLIS-CHALMERS** 





# Here's why Pangborn Dust Control boosts employee morale!

The answer is in this book. You'll see why Pangborn Dust Control makes your employees happier, healthier, more efficient in a dust-free plant. Why machinery life is lengthened, housekeeping costs reduced. Why you can reclaim valuable material for salvage. Why you can improve community relations.

Why Pangborn Dust Control? Because Pangborn offers the most efficient methods of dust collection on the market. Pangborn has spent 50 years dealing with dust problems . . . experience that is incorporated in every proposal. And Pangborn's extensive line of wet

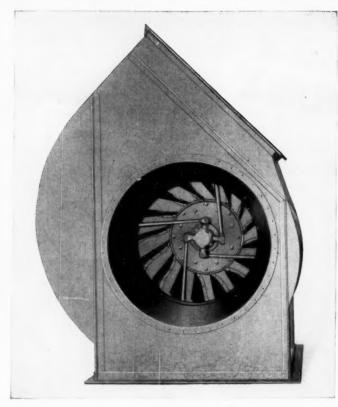
and dry collectors means that one of these units can be adapted with maximum effectiveness to any problem.

Send for your copy of "Out of the Realm of Dust." And remember: the Panghorn Engineer in your area will be glad to take off his coat and go to work on your dust problem at no obligation. PANGBORN CORP., 2600 Panghorn Blvd., Hagerstown, Md. Manufacturers of Dust Control and Blast Cleaning Equipment.

Pangborn CONTROLS



DUST



# CORROSIVE GASES HANDLED WITH LESS MAINTENANCE LESS DOWNTIME

"BUFFALO" RUBBER-LINED FANS

- Longer Fan Life Proved in hundreds of installations over a period of more than 30 years, actual records show that up to 12 times the life of ordinary metal fans may be expected from "Buffalo" Rubber-Lined Fans in severe corrosive fume service. Thus you will spend very little time maintaining the "Buffalo" equipped system in your plant.
- Economies effected in the reduction of downtime are equally impressive. The overall savings of longer life plus decreased downtime pay the slight additional cost of rubber lining many times over. A fact executive management can readily appreciate.

The "Buffalo" method of rubber-lining assures permanence. The rubber is actually "welded" into the pores of the metal with a union that is practically integral. With the "Buffalo"

Rubber-Lined Fan, corrosive fumes cannot touch metal the inside of housing, rotor and shaft are completely rubberprotected.

Whatever your corrosive fume handling problem, your nearby "Buffalo" Engineering Representative will recommend the type of "Buffalo" Rubber-Lined Fan best suited to your requirements. Contact him, or write us for Bulletin 2424-F.

OTHER SPECIAL "BUFFALO" FANS FOR SPECIAL CONDITIONS - If you have a special air or materials handling job involving severe conditions ranging from corrosive fumes to abrasive dust, investigate "Buffalo" Resin-Bonded Fiber Glass Fans . . . Industrial Exhausters . . . Volume Fans...Pressure Blowers and Centrifugal Exhausters... Electric Blowers and Exhausters.

Every "Buffalo" product features the famous "Q" Factor - the built-in QUALITY that provides trouble-free satisfaction and long life.

# BUFFALO FORGE COMPANY

BUFFALO. NEW YORK

BUFFALO PUMPS DIVISION, BUFFALO, N.Y. Canadian Blower & Forge Co., Ltd., Kitchener, Ont.



VENTILATING AIR CLEANING

AIR TEMPERING

INDUCED DRAFT

EXHAUSTING FORCED DRAFT COOLING

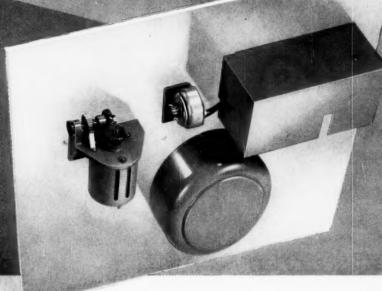
HEATING PRESSURE BLOWING

# DAYSTROM-WESTON MULTI-POINT POTENTIOMETER RECORDER

Simplest . . . most efficient . . . easiest to maintain . . .



through UNITIZATION\*



"UNITIZATION:

the grouping of related components — in Daystrom-Weston Potentiameter Recorders — in the simplest, most serviceable, most efficient manner.

This versatile instrument collects information from as many as 24 sources, sorts it, and prints it with high accuracy in the form of up to 24 independent, simultaneous records. These functions are complex. But the instrument which performs them is neither complicated, cluttered nor delicate . . . thanks to Daystrom-Weston's UNITIZED DESIGN.

Parts are kept to a minimum, and integrated into compact, easily accessible panels. Spare-parts inventories are greatly reduced—due to interchangeability of components. There is no jungle of wires to hamper inspection and maintenance.

Routine servicing takes only seconds. Adjustments and circuit changes are made easily and without interrupting operation. All parts are designed for strength and shock resistance... to maintain alignment throughout years of hard usage.

The unique etched circuit switch is geared to the printing head...can't get out of synchronization. Up to 6 general or selective alarm contacts can be added in the factory or field.

You see above, the unitized measuring-selecting panel of the multi-point instrument. In most other respects, this recorder is identical in construction, and offers the same advanced performance and maintenance features as the DAYSTROM-WESTON SINGLE-POINT POTENTIOM-ETER RECORDER and RECORDER-CONTROLLER.

For full information on any of these instruments, call your local WESTON Representative, or write to WESTON Instruments, Division of Daystrom, Inc., Newark 12, N. J. In Canada: Daystrom Ltd., 840 Caledonia Rd., Toronto 10, Ont. Export: Daystrom Int'l., 100 Empire St., Newark 12, N. J.

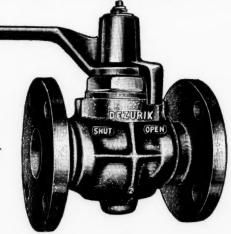
# **DAYSTROM-WESTON**



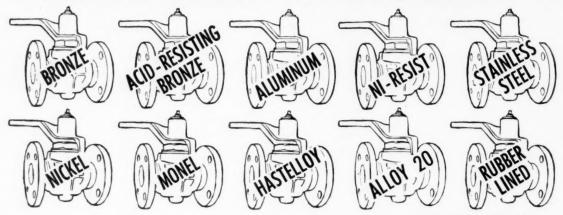
Industrial Instruments

# WHAT'S YOUR CORROSION PROBLEM?





# DeZurik Valves are available in



AND OTHER METALS

PLUGS ARE AVAILABLE WITH HYCAR, NEOPRENE, HYPALON, HARD RUBBER OR TEFLON FACING.

DeZurik Valves' complete range of materials is matched by a complete line of models: manual, pneumatic, hydraulic or electric operation. DeZurik's exclusive eccentric action guarantees dead-tight shut-off and easy operation without lubrication! For more details on DeZurik Valves write to

Representatives in all principal cities.



March 24, 1958—CHEMICAL ENGINEERING

REMOVE UNWANTED MOISTURE...

boost quality and output by drying with Lectrodryer®

PROCESSING, PACKAGING, and STORAGE operations are safe-guarded by surrounding them with consistently dry air—air dehumidified by Lectrodryers. Quality of products is protected... and production is maintained at top speed.

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Lectrodryers come to you fully assembled, with electrical, mechanical and DRYing functions tested for right-from-the-start operation.

Connect them to power and they're ready for work.

THIS COUPON BRINGS YOU DRYING HELP

Pittsburgh Lectrodryer Division McGraw-Edison Company 303 32nd Street, Pittsburgh 30, Po. Unwanted moisture is causing trouble.

Send data on how Lectrodryer can assure DRYness in —

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Leading industries look to



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World's First and Foremost Manufacturer of Commercial and Industrial Adsorbent Driers





Write for bulletin B-2406 for further information on 1 to 125 hp corrosion-proof motors.

# RELIANCE ENGINEERING CO.

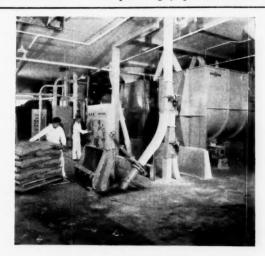
DEPT. 133A, CLEVELAND 17, OHIO CANADIAN DIVISION: TORONTO, ONTARIO Sales Offices and Distributors in Principal Cities



B-167

Published in the interest of better processing by Sprout, Waldron & Co., Inc., Muncy, Penna.

# Versatile Starch System Steps Up **Capacity**



Blending and packaging starches at the new Morningstar Nicol plant is faster, cleaner and more economical thanks to pre-planning for versatility, selection of the right unit machines and air handling.

Vice President Edward Hillary credits advance planning of the entire system with Sprout-Waldron engineers for the extreme versatility. Material may be injected as received, or passed through S-W precrushers and grinders. From one control point, the operator may direct the material into either of two S-W mixers, or bypass them. From the mixers he can discharge and pass through sifters, or if he chooses, bypass them. He can mix and sift, mix without sifting, or dump material from any one of three floors and bypass all mixing and sifting.

Movement of the material is handled by Pneu-Vac, the S-W negative pressure air handling system. This means minimum dusting and trouble-free operation even when moving starch at rates up to 30,000

lbs./hr. Chief Chemical Engineer, Ken Sterrett lived with this installation from the beginning. If you have any questions, he's your man.

# PELLETS CUT COSTS

Pelleted materials are attracting wide interest in chemical and related process industries because their many advantages are being translated into lower operating costs and fewer problems.

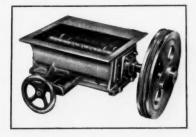
By compressing powders into dense pellets we get material which is dust free; easy to handle, store or package; more economical for drying or cooling; safer and more pleasant to process.

Sprout-Waldron's Pellet Ace has been specified for cellulose acetate, Fullers earth, clay, coal, detergents, graphite, insecticides, kaolin, lignite, polyethylene, sodium nitrate and nitrite, superphosphates, etc. Ask for Bulletin 182 or send your pelleting problems to Joe Grahek, Chief Engineer, Pellet Division.

# Salt Slabs Reduced With 18" Crusher

In the manufacture of cellulose sponge it is necessary to reduce the large slabs of glaubers salt, before they can be used efficiently. Although the S-W Single Roll Crusher seemed like a natural for this application, it had to be "adaptioneered" in order to minimize the production of fines which usually occur when handling a material so friable.

"Adaptioneering," the science of adapting standard equipment for special engineering applications is a Sprout-Waldron specialty. For example, Model 104 Single Roll Crusher has been used for reducing



glass, plastics, coal, coke, charcoal, carbon, sulphur, salt, clay, silica gel, urea, dye, bricks, paint pigment, brake linings, roofing shale and a wide variety of other difficult to handle materials. For the facts about this versatile crusher, write for Bulletin 116-A; for assistance in any size reduction problem, contact any S-W representative or drop a note to our Engineering Department.

Sprout-Waldron has a condensed catalog available for your use. Ask for Bulletin 178.

# Leciders in Your Industry Have Selected "NATIONAL" as the Leader in the Field of PERFORATED APRON-TYPE CONVEYOR DRYERS

Famous names among the manufacturers and processors of chemicals, fibers and allied products are proudly listed in the growing roster of "NATIONAL" customers.

These companies, by their selection of "NATIONAL" Perforated Apron-Type Conveyor Dryers, have demonstrated their belief in the outstanding leadership which "NATIONAL" has earned in the design and construction of this and related types of drying and conditioning equipment.

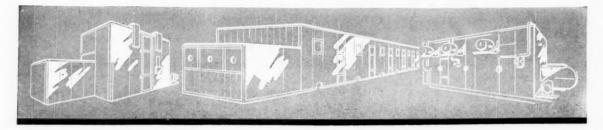
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# EC&M OIL-BREAK STARTERS

(2200-4800 VOLTS)

-THEY'RE Specifically Designed FOR DUSTY, CORROSIVE ATMOSPHERES

ECaM Type ZHS Starters are a "natural" for chemical plant service because the high interrupting capacity ZHS contactor operates under oil. Being totally oil-immersed, this contactor is always well lubricated, protected from corrosion and requires infrequent inspection. There are additional advantages—

QUICKLY INSTALLED because starters are shipped with all internal wiring complete. These ready-to-use starters cut installation time and cost.

HIGH INTERRUPTING CAPACITY • These EC&M Starters are available in enclosures for indoor or outdoor mounting, and are supplied in 3 ratings—(1) 50,000 KVA (certified) interrupting capacity (inherent in the starter)—(2) with power-type, current-limiting fuses—(3) VALIMITOR® (volt-ampere-limitor), the bus may be of unlimited KVA.



Exterior and interior views of

EC&M Type ZHS High Voltage

Starter in NEMA 3R (raintight) en-

closure with threaded connections

for conduit

With EC&M contactor-lifter, contactor is easily raised above oil level for easy inspection without disconnecting any bolts or leads

0 0 0



Down-view into oil tank. Note compactness of contactor and transformer assembly. All leads are anti-syphon



An installation of two EC&M 2300 volt, reversing dynamic braking starters in a large rubber plant

For the complete story, write for Bulletin 8130-CH



THE ELECTRIC CONTROLLER & MFG. CO.

A DIVISION OF THE SQUARE D COMPANY

8170

# Your Armco Stainless Steel Distributor Can Save You Time and Money



Your distributor of Armco Stainless maintains a Steel Service Center that offers you special time- and moneysaving opportunities.

His complete stocks of the types of stainless used for chemical equipment assure you a dependable supply of

the grades, sizes and gages to meet your requirements. You have a rent-free warehouse of performance-proved Armco Stainless Steel that can be delivered in a hurry.

Armco Distributors also offer you opportunities to cut fabricating costs by shearing, sawing or slitting your stainless to your exact specifications. And mill trained engineers and salesmen, backed by Armco's research and engineering staff, can provide valuable assistance in grade selection and fabricating procedures.

When you buy stainless steel, take advantage of the many time- and money-saving services offered by your Armco Stainless Distributor. Get acquainted with him today.

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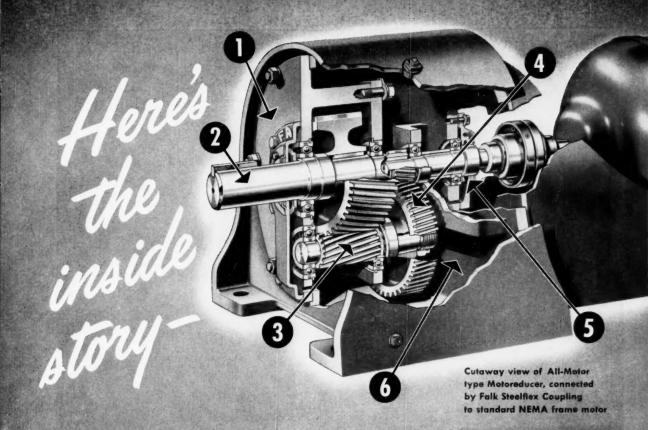
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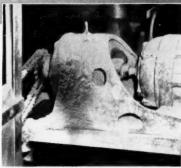
# **WHY Falk Motoreducers** give better service-have longer life

Here is the "inside story" behind the all-steel All-Motor type FALK Motoreducer's universal reputation as a gear drive unmatched in quality, efficiency, dependability, ease of maintenance and long life. These "In-built" factors are-

- ALL-STEEL HOUSINGS. Rugged, strong, rigid...all parts are manufactured from heavy steel plate, formed and welded in the Falk Weld Shop.
- LARGE OVERHUNG LOAD CAPACITY. Large shafts, oversize bearings...rigid mountings with wide bearing spans to handle maximum applied loads.
- PRECISION GEARING. Heat-treated alloy steel gearing, precision cut and shaved after heat treatment to eliminate distortion. Quiet, crown-shaved pinions.
- 4 EXTRA-CAPACITY GEARING. Special extra-capacity gear-tooth form with larger contact area gives greater strength, higher load-carrying capacity.
- SEALED HOUSINGS. Splashproof, dustproof, oil-tight construction. Dual closures and one-way vents keep oil in, dust and moisture out.
- 6 POSITIVE LUBRICATION. Large sump capacity...oiltight construction assures clean lubricant...revolving elements lubricated by direct dip.

When you buy or specify the All-Motor type FALK Motoreducer, you get all these plus the tremendous advantage of full interchangeability of motors. Switch motors as desired—use any make, style or type of standard foot-mounted motor within the unit's AGMA rating—with a minimum of difficulty or "down time."

Available in sizes up to 75 hp-with or without motor-from convenient factory, field or distributor stocks, from coast to coast. Write for Bulletin 3100.



# 60,000 HOURS WITHOUT A FAILURE!

Sixty thousand hours is a lot of hours-but the FALK Motoreducer in the unretouched photo above has served that long without failure or need of repair.

This 3 hp unit is one of over 60 FALK Motoreducers in daily service in an Eastern plant of a large milling company, whose president says, in part:

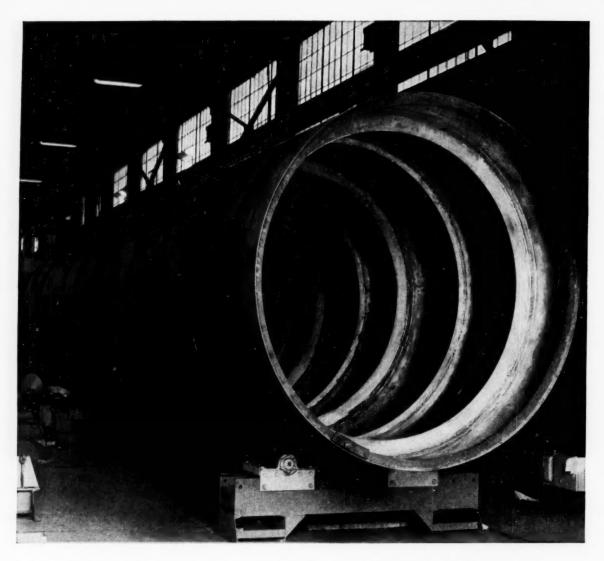
"One of the main advantages of FALK Motoreducers is their adaptability to any motor. Reducers and motors can be easily interchanged.... Our service records confirm the wisdom of our choice of FALK equipment as our standard."

# THE FALK CORPORATION, MILWAUKEE, WISCONSIN

# MANUFACTURERS OF

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives Herringbone Gears
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Marine Drives Steel Castings
  - Weldments
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# For Storage at 297° Below...Under Vacuum

Liquid oxygen is cold stuff. Boiling at 297° below zero, it must be contained in a thoroughly insulated vessel to prevent intolerable evaporation losses. This 9′ x 40′3′ section, of Type 304 stainless, is the inner compartment of a giant vacuum bottle for liquid oxygen storage. To assure a perfect vacuum, the welds must remain tight over a wide range of temperatures, requiring extreme care in selection of materials and laying in of welds. Applying experienced craftsmanship to such fabrication problems as this is nothing new at Graver. Many years of cryogenic research assures a safe, trouble-free, low-temperature vessel that will give long service. At whatever temperature your product must be stored or processed, you will find the type of custom fabrication you require at Graver.



Building for the Future on a Century of Craftsmanship in Steels and Alloys

# GRAVER TANK & MFG. CO.. INC.

EAST CHICAGO, INDIANA

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# Why a Steam Trap Has to Handle "Air"

# Low temperatures and corrosion of equipment are often evidence of inadequate trap air venting capacity

Air, with its load of oxygen and carbon dioxide, has an unwholesome habit of interfering with the efficiency of steam heated units. If steam were always free of these undesirable companions, things would be a lot simpler for men-who-operate-plants. Because it isn't, three unhappy situations frequently occur:

1. Operating temperatures are subnormal. This is a two-part problem. First, an air-steam mixture has a lower temperature than pure steam at the same pressure—see Table A. Secondly, air can "plate out" on heat transfer surfaces as shown in Figure 1. Under some conditions, such an air film will knock down heat transfer efficiency by as much as 50%.

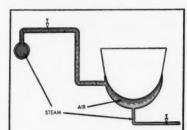


Fig. 1. How air can "plate out" on heat transfer surfaces. This "insulation" drastically reduces heat transfer efficiency. Armstrong trap operation creates turbulence in the equipment that prevents this.

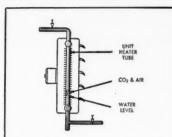


Fig. 2. Corrosion occurs when units are not kept continuously free of both condensate and air. Armstrong traps discharge both, at steam temperature, as fast as they accumulate.

2. Corrosion rears its ugly head. Oxygen and carbon dioxide are real trouble-makers. CO<sub>2</sub> gas goes into solution in condensate, forms carbonic acid and chews away at vulnerable metal sections. O<sub>2</sub> aggravates the situation. See Figure 2.

TABLE A—How air reduces steam temperature.

Gauge Pressure	Temp. of Steam with No Air	Temp. of Steam Mixed With Various Amounts of Air (% Air by Volume)	
	Present	10%	30%
10.3 25.3 50.3 75.3 100.3	240.1 267.3 298.0 320.3 338.1	234.3 261.0 291.0 312.9 330.3	220.9 246.4 275.1 295.9 312.4

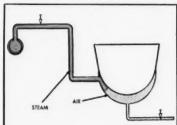


Fig. 3. When steam is turned on, it takes a trap with extra air venting capacity to provide fast heat-up.

3. **Heat-up is slow as a snail.** Air has a picnic in units that are shut off periodically. Figure 3 pictures the problem. Lines and equipment literally fill up with air. When the steam is turned on it can get in only as fast as the air gets out.

# **Enter Steam Traps**

Curing these steam system ailments involves an operation sometimes called a "trap transplant." It consists of removing traps that don't get the air out and replacing them with traps that do.

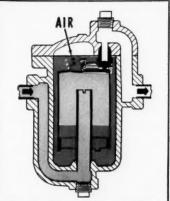
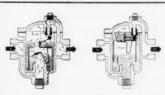


Fig. 4. Air entering an Armstrong trap passes through the bucket vent and accumulates in the top of trap. When trap opens, air is discharged along with condensate.

Figure 4 shows how an Armstrong inverted bucket trap continuously vents air. What the picture doesn't show is a built-in plus-value of this trap's design. An Armstrong trap opens suddenly, creating a momentary pressure drop and turbulence in the unit being drained. This breaks up air films and "pumps" air down to the trap so it can be vented.

The vents in standard Armstrong trap buckets will pass all the air normally encountered. In special cases, such as paper machine dryers, the vents are correctly sized larger at the factory to meet the requirement.



Thermostatic vent open.

Thermostatic vent closed.

Fig. 5. Open float with thermostatic vent for off-and-on units. When trap is cold, vent is open, permitting air to blow through when steam is turned on. When steam reaches trap, heat closes thermostatic vent. Then, regular bucket vent handles all air coming in with steam.

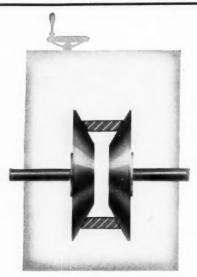
# Open Float with Thermostatic Vent

Super air-venting capacity is a must for fast heat-up of low pressure unit heaters, heating coils, steam headers and other units that are on-and-off. Figure 5 shows how the Armstrong open-float-with-thermostatic-vent trap takes care of this.

The 44-page Armstrong steam trap book covers other features of the Armstrong trap as well as its excellent air handling characteristics. This catalog also discusses trap selection, installation and maintenance. Your local Armstrong Representative or Distributor will be glad to give you a copy. Call him, or write Armstrong Machine Works, 8582 Maple Street, Three Rivers, Michigan.



# Now! See why American Blower Gýrol. Fluid Drive is your best adjustable-speed investment!



FRICTION-TYPE DRIVE

Friction-type drive is subject to heat, wear, and tension. Mechanical connection transmits shocks. Speed control varies with wear.

Comparison proves: Gýrol Fluid Drive protects against shock far better than friction-type drives; gives more accurate speed control; reduces maintenance!







GYROL FLUID DRIVE Vortex of oil isolates shock. Stepless, adjustable speed is controlled by a simple, wear-free speed controller.

# Compare—then specify Gýrol Fluid Drive

	FEATURE	GYROL FLUID DRIVE Type VS Class 2	FRICTION-TYPE DRIVE
1.	Shock pro- tection	Vortex of oil isolates shocks.	Mechanical connection transmits shocks.
2.	Maintenance record	Good—few wearing parts; extra-long serv- ice life.	Poor—multiple wear- ing parts; power trans- mitted by friction.
3.	Accuracy	Simple, wear-free speed control.	Wear and tension affect control.
4.	Service limit		Limited—service fac- tors influence selec- tions.
5.	Horsepower rating	Units available up to 800 hp.	Units available to 100 hp.



Type VS Class 2 Gýrol Fluid Drives, compact and selfcontained, come in sizes from 1 to 800 hp. Other classes handle up to 12,000 hp. Get full information today! Contact one of our 73 branch offices, or write: American-Standard,\* American Blower Division, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

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pressure drop, for high or low flow rate, pressure, pH, temperature and viscosity. Complete engineering facilities are at your service.

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on equipment purchase orders will save you a lot of money!



When you buy processing equipment that will be exposed to the attack of corrosive fumes or chemicals, you can save yourself future headaches and maintenance expense by adding the one extra line:

"This equipment is to be protected with Tygon Paint, applied as per the instructions of The U. S. Stoneware Co."

It should add little to the cost of the equipment. It will add years to its life. For Tygon Paint has been proved by years of exposure to such corrosives as sulphuric, hydrofluoric, nitric, hydrochloric, sodium hypochlorite, potassium hydroxide — in fact, to most corrosive agents. (There are

a few, of course, to which Tygon is not fully resistant\*).

To safeguard your equipment against "downtime" from corrosive attack, specify "to be protected with Tygon Paint".

\* Bulletin 760 gives full technical data on Tygon Paints together with performance data under exposure to over 150 corrosives. Write for it today.



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# Chemical Engineering

# Developments

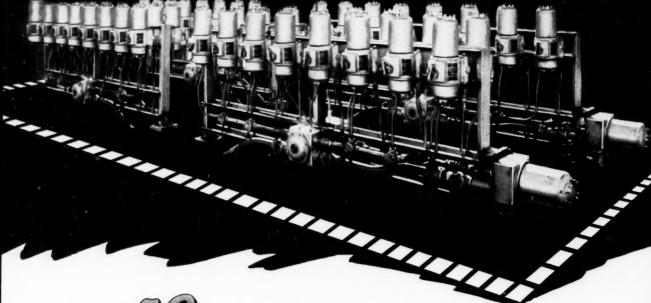
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"When you deal with evanide, chlorinate," says an old industrial proverb. But process success using ozone instead proves that the old premise ain't necessarily so.	
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# CROUSE-HINDS Condulet\* motor controls Occupy Less Space!





Explosion-Proof Combination Motor Starters and Circuit Breakers . . . in a 25 ft. x 6 ft. Area!

Crouse-Hinds Condulet\* Type EPC Motor Starters and Circuit Breakers are explosion-proof, dust-tight (dustignition-proof) and weather-resistant (raintight).

Lightweight cast aluminum construction for easy installation without use of lifting equipment.

Seven Conduit entrances simplify installation.

Built-in push button stations and selector switches are available.

Starter sizes 0 to 5. Circuit breakers 50 to 600-amp. frame sizes.

In the installation shown above, 48 Crouse-Hinds Condulet\* Type EPC combination motor starters and circuit breakers are compactly arranged in four racks.

If necessary, the 25 ft. x 6 ft. area used could have been cut in half by installing the Condulet motor controls in two tiers. Or, twice as many Condulet controls could have been installed in the same area, if required.

The vertical design of Crouse-Hinds motor starters, circuit breakers and combinations allows them to be installed only  $\frac{1}{4}$ " apart. This compactness produces savings in the construction of steel mounting racks, and in the use of premium floor space.

● For help in solving a space problem, see your Crouse-Hinds distributor . . . or call the negrest Office listed below

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MARCH 24, 1958'

# Chementator

C. H. CHILTON

# √ Hercules Powder has pilotplanted a new continuous process for nitroglycerine nitration and separation, claims it represents a significant improvement over

conventional equipment.

- √ Fractional distillation of byproduct sulfur to rid it of selenium is International Nickel's coup de grace in its new nickel refining process. Watch for details in next issue.
- √ New synthetic fiber—still unidentified—will be made in Puerto Rico by Beaunit Mills. Evidence points to nylon-11: Beaunit has been eyeing nylons for some time; Rilsan Corp. has been dickering with a U. S. firm on licensing; plant site is well located geographically to handle Brazilian castor oil, raw material for nylon-11. Other trade rumors suggest a new polyester.

# Kiln control wins direct iron success

Republic Steel and National Lead unveiled their jointly developed R-N process for direct reduction of iron ore at the AIME annual meeting last month in New York, revealing a chemical engineering technique simple in principle but replete with specialized know-how.

Reduction takes place in a gas or oil-fired kiln, with countercurrent feed of ore, carbonaceous reducing agent and dolomite. Careful control of combustion to achieve required temperature and atmosphere throughout the length of the kiln is the key to smooth operation. This is accomplished by admitting adjustable quantities of air to the kiln through special ports spaced along the kiln length.

Figures presented by Republic's Don Babcock show a remarkably flat temperature profile of 1,950 F. over a major length of the 9x150-ft. pilot kiln. This is a low enough temperature to avoid fusion or sintering of the charge but still represents good efficiency. Gases leave the kiln at about 600-700 F. and carry only a small percentage of unburned fuel. Depending on grade of ore feed, the magnetically or gravity-separated product contains as much as 95% total iron, with over 90% in metallic form.

Republic's 175-ton/day pilot plant near Birmingham, Ala., has successfully treated some 100,000 tons of ore. Process is available on license through the recently formed R-N Corp., New York.

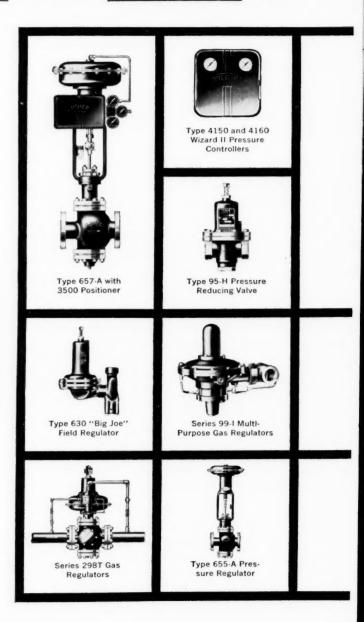
# Refinery gets 80% yield of gasoline

In a processing scheme akin to that used by American Gilsonite Co. to make gasoline and coke from melted gilsonite (*Chem. Eng.*, Nov. 1957, pp. 222-225), Pontiac Eastern Corp.'s new \$20-million refinery at Purvis, Miss., is now producing 11,500 bbl./day of gasoline and 200 tons/day of coke. Of the

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14,500 bbl./day refinery charge, 70% is sour, viscous Mississippi crude oil; the balance is field distillate.

Whereas AGC's refining process is a relatively simple sequence of static-bed delayed coking, Unifining and Platforming, PEC uses a more complex flowsheet to get an unusually high (80%) yield of gasoline. Process key step is integration of continuous fluid coking into the flowsheet.

With little outlet for heating oils in its marketing area, PEC has majored on gasoline production. This accounts for the fairly high investment per bbl. of charge.

In addition to liquid fuels and coke, the new refinery is equipped to turn out 27 tons/day of recovered sulfur.

# Low conductivity throttles heat flux

	k Values
Min-K, 200-400 F	. 0.14-0.19
1,000 F	. 0.27
Rock wool, 200-400 F	. 0.41-0.53
Diatomaceous earth brick, 1,000 F	0.88
Still air, 390 F	. 0.27
570 F	

Johns-Manville's new molded thermal insulation, Min-K, boasts a thermal conductivity less than half that of conventional insulations and even less than that of still air.

What accounts for Min-K's low conductivity? J-M, while vague on specifics, explains Min-K in terms of these general principles:

- Pore size is so small that "a large proportion of the gas molecules collide with the walls of the structure rather than with other molecules." This minimizes heat transfer via molecular conduction through the gas.
- Min-K incorporates "opacifying media" which minimize heat transfer via radiation through the insulation.

With pore size less than the mean free paths of oxygen and nitrogen molecules (about 0.1 micron), particle size of the unidentified particulate components is presumably in the same range. This would suggest that Min-K contains some material like Micro-Cel synthetic calcium silicate which, says J-M, provides particle sizes as small as 0.02 micron. And possibly Min-K's low radiation transfer is due to some material like fumed zinc, which would have low emissivity as well as small particle size.

Johns-Manville is grooming Min-K for the rocket, missile and jet aircraft markets. As a lining for nose cones, for example, it can protect the delicate guidance system inside from the frictional heat generated upon re-entry into the atmosphere. A ½-in.-thick layer of Min-K laminated to the inside surface reduces the temperature from a torrid 2,000 F. to a tolerable 350 F.

J-M reports that Min-K is now used in an operational missile which has been test-fired successfully.

# New rubber stands up to heat, solvents

Du Pont starts production this month at Deepwater, N. J., of a new family of elastomers reported to excel all other available elastomers in heat and chemical resistance. Called Viton perfluorocarbon rubbers, they are copolymers of vinylidene fluoride and hexafluoropropylene.

Viton rubber products will resist 600 F. for 24 hr., 400 F. for 2,400 hr. Vulcanizates stand up to aliphatic, aromatic and chlorinated hydrocarbons, aromatic amines, dilute or concentrated mineral acids and alkalis.

This combination of properties appears to fill a gap left by silicone rubbers—strong on heat resistance, not so good against fluids—and acrylonitrile rubbers which, though outstandingly fluid-resistant, leave much to be desired in heat resistance.

Unlike silicone rubbers, the new elastomers are almost as easy to process and fabricate as standard GR-S, says Du Pont.

Uses are expected in jet engines, automotive equipment, protective linings and coatings, packings, seals, fuel cells and adhesives.

# Direct hydrogenation gets the nod

Two late news stories from Britain emphasize the timeliness and significance of this month's report on gas manufacturing processes (pp. 121-132):

- Northwestern Gas Board announced plans for building a plant at Partington (near Manchester) to make high-Btu. gas via direct hydrogenation of oil or low-grade coal. Plant capacity: 7.5 million cu. ft./day; cost: \$5.6 million. Hydrogen will be made from oil by Texaco partial oxidation process.
- Scottish Gas Board will build an \$18-million, 30-million-cu.-ft./day gas plant at

(Continued on page 60)

# Yes, the Halogen Fluorides

# are commercially available

# from B&A!

With the exception of elemental fluorine, the Halogen Fluorides are the most reactive chemicals known. They react with the vast majority of inorganic and organic compounds and with many metals. These unique characteristics suggest many interesting paths of research for the alert investigator to follow—particularly where vigorous incendiary or fluorinating agents are indicated.

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Westfield, Fife, which will combine the Lurgi high-pressure process for gasifying low-grade coal with an oil hydrogenation unit. Low-Btu. gas from the well-established Lurgi process will be enriched with high-Btu. gas from the new hydrogenation process.

Direct hydrogenation offers some attractive advantages over the more-thoroughly studied alternative route to high-Btu. pipeline gas—production of a hydrogen-carbon monoxide synthesis gas followed by methanation. In the U. S., Institute of Gas Technology ("hydrogasification") and Bureau of Mines ("hydro-carbonization") have led in process development work.

Largely because of different economic incentives, the British direct hydrogenation work, under the direction of F. J. Dent of the state-owned Gas Council, has made substantial progress. The council's West Midlands research station already has a 1-million-cu.-ft./day hydrogenation pilot plant.

The noncatalytic Dent process operates with a fluidized bed of coke. Coke deposited in the process is withdrawn from the bed, similar to Esso's fluid coking process. Operating pressure is as much as 600 psi. and temperature as high as 800 C.

# BW defenders uncover new germ-killer

Army Chemical Corps has just revealed that beta-propiolactone vapor is an excellent germ-killing agent for sterilizing hospital rooms and bacteriological laboratories. This discovery grew out of Chemical Corps research to develop defense techniques against biological warfare.

Other chemicals used for similar purposes are formaldehyde and ethylene oxide. The Army found beta-propiolactone to be several times faster than formaldehyde, less irritating and more rapidly dissipated by simple airing. Ethylene oxide vapor, while showing many advantages as a sterilizing agent, is rather slow-acting and can thus tie up valuable space for too long a time. The Chemical Corps has used beta-propiolactone at Fort Detrick to disinfect entire laboratory buildings, keeping them out of operation only a day or so in the process.

The Army's disclosure, made in a lecture at Seton Hall College of Medicine & Dentistry, triggered a Celanese announcement that betapropiolactone has been in commercial production at Pampa, Tex., since November. Process was developed originally by B. F. Goodrich Chemical under an Army research grant, and Goodrich at one time sold the lactone commercially. Process involved reaction of ketene (made from acetone) with formaldehyde. Goodrich used the lactone to make beta-alanine, an intermediate in vitamin synthesis, by reaction with ammonia (Chem. Eng., Jan. 1953, p. 116).

Celanese has bought the process from Goodrich, added its own modifications and now supplies Goodrich's needs as well as its own

# Don't write off the uranium boom

What effect do the recent U.S. and U.K. announcements of progress towards thermonuclear power have on the health of our infant domestic uranium industry? None whatever, reassured Paul F. Genachte, atomic expert of Chase Manhattan Bank, speaking to uranium producers last month at the National Western Mining Conference in Denver.

"Although much progress has undoubtedly been accomplished," said Genachte, "we are still far from a point comparable to the first self-sustained fission reaction of uranium in December 1942. For a long time to come, we are going to put large amounts of energy into these experiments instead of getting any out."

Pointing out that fusion, if and when harnessed, appears to be economic only in very large plants, Genachte concluded that fusion will complement fission and will not put it out of business.

Other speakers at the same meeting did their bit to dispel some of the gloom which has hung over the Colorado Plateau in recent months:

- William Krebs of Arthur D. Little, Inc., in estimating future demands for uranium for both power and weapons, described the picture, be it short, intermediate or long range, as "one which should give confidence to the world uranium industry, and particularly to U.S. miners and producers."
- AEC's Jesse Johnson revealed that the commission was studying the question of a free market for uranium, acknowledging the fact that domestic  $U_3O_8$  concentrate could now be produced in greater quantity than required for AEC contracts.

# For more on DEVELOPMENTS......62

Hedum Pressure\*
Oil-Free Air-



# you need a BROWN BOVERI ISOTHERM COMPRESSOR

WHERE large volumes of oil-free air (5,000 SCFM and up, 100-300 PSIA)\* are required, there is no better equipment available today to achieve "close to isotherm" type of compression, assuring the lowest possible kW input, than a Brown Boveri Isotherm Compressor.

If "tail" gas is available, the high efficiency, reaction type Brown Boveri expander can be applied in the cycle with the Isotherm Compressor to improve further the economy of the process. As drive for the compressor a synchronous, induction or other type of motor, or a steam- or gas-turbine can be used.

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# PROCESSES & TECHNOLOGY C. S. CRONAN

# Radiation Chemistry Gets Closer Scrutiny

Radiation chemistry, child prodigy several years ago, has reached the point where it must now prove itself as a useful processing tool. Slowing advance of this science is the fact that no one really understands the mechanism of radiation-catalyzed reactions.

To probe deeper into this relatively unexplored area, Argonne National Laboratory, Lemont, Ill., is installing an electron accelerator rated at 18 million electron volts. Built for Argonne by Applied Radiation Corp., unit will be used for detecting directly short-lived intermediate products of radiation-catalyzed reactions. Previously, information about intermediate reaction stages has been deduced by working back from end products.

Experimental technique will be similar to that used in flash photolysis. Intense bursts of

electrons (instead of light bursts) will create transitory particles, such as ions and free radiation, in sufficient amounts for direct detection. Then scientists will know for sure if their deductions have been correct.

▶ Radiation for Rent—Another first is reported in radiation field—a radiation rental facility has been opened in Rockford, Ill. Said to be the first private company offering radiation service as a profit-making venture, facility is a joint project of Applied Radiation Corp., Walnut Creek, Calif., and the W. F. & John Barnes Co. of Rockford.

Firm's 8-mev. electron accelerator is available on an hourly rental basis for companies wanting to start radiation research but not wanting to invest money in their own setup.

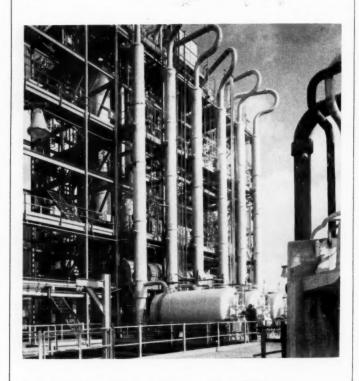
# For Ni-Co Process, Largest H<sub>2</sub>S Plant

Many schemes have been worked out to rid process streams of hydrogen sulfide. Girdler Construction Div. of National Cylinder Gas is bucking the trend: It's engineering a process to produce 60 tons/day liquid H<sub>2</sub>S for injection into a metal-refining circuit.

First large-scale H<sub>2</sub>S plant ever used in ore processing, unit will be part of Freeport Sulphur's nickel-cobalt mining operation at Moa Bay, Cuba. H<sub>2</sub>S will be used in precipitating a mixed nickel-cobalt sulfide that will be shipped to the U.S. for metal recovery.

In Girdler process, hydrogen, at 150 psig., is fed continuously to reactor containing a bath of molten sulfur. At 800-900 F., hydrogen sulfide forms, maintains temperature by exothermic heat of reaction. Molten sulfur is continuously added to maintain proper level in reactor.

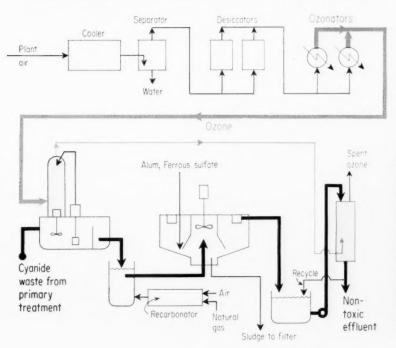
Plant's raw materials, sulfur and liquified petroleum gas, will come from the U.S. Hydrogen for process is made by reacting LPG with steam over a catalyst at 1.500 F.

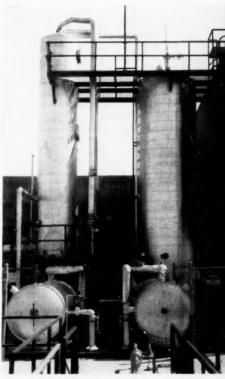


## **Britain Makes Silane Fractions for Silicones**

Silicones, originally discovered in Britain as a laboratory curiosity, are now finding wide commercial use. Shown here are still pots and batch distilling columns at Barry, England, plant of Midland Silicones, Ltd., used for splitting methyltrichloro-, dimethyldichloro-, and trimethylchloro - silane — building blocks for wide variety of silicones.

# Two-Stage Contacting Oxidizes Cyanide





# Ozone Counters Waste Cyanide's Lethal Punch

Major new installation proves that ozone's top performance is matched by favorable costs.

"When you deal with cyanide, use chlorine," has been an industrial waste-disposal watchword for a good ten years. But a newly installed ozonation setup at Boeing Airplane's Wichita, Kan., plant leads us to believe that the old premise ain't necessarily so.

Wilson & Co. of Salina, Kan., engineers for a new \$1.5-million waste treatment facility to serve Boeing's metal working plant, chose ozone as the best allaround bet to handle the 0.0-25 ppm. cyanide content in Boeing's 500 gpm. plant effluent.

Says a Wilson spokesman of the Boeing installation: "First costs for this equipment, when you take account of all things, are comparable to those entailed to install an equivalent chlorine treatment plant, may even be slightly in ozone's favor. Operating costs for ozone treatment are substantially lower."

Covers Broad Spectrum—Cyanide destruction isn't ozone's only job at the Boeing plant. Equally important to Wilson is the oxidant's ability to deal with a variety of residual wastes with chemical oxygen demand sulfides, sulfites, phenols and oils—that get by other waste removal operations. Chlorine would not effectively handle all these materials.

Chemical engineer Robert Selm, who headed up the whole project for Wilson, says he would have "strongly recommended" that ozone be employed even if there were no cyanides to oxidize.

Clears Cost Hurdle—All this is a pretty strong endorsement for a chemical oxidant which has never been used before for any industrial waste. There's been plenty of evidence over the years that ozone could do a clean, fast job on cyanide wastes. But the cost factor always seemed to get in the way.

At the Boeing plant, however, the economics appear to favor ozone—just as Welsbach Corp., foremost maker of ozone-generators, has maintained they would in many instances.

Basis for Welsbach's contention that ozone first costs need be no higher than chlorine's lies in seven words from Wilson's statement above: "... when you take account of all things. . . ." For although a chlorinator is a darn sight cheaper than an ozonator, there are a lot of extras which may accompany chlorine treatment: large detention basins, facilities for chemical handling and storage (e.g. a gas-tight room for chlorinators), railway spurs for moving chlorine cylinders, dechlorinating equipment. And if the waste effluent goes to a low-flow stream, you may have to reckon with chloride content.\*

▶ Follows Primary Treatment—Before ozonation, wastes from the Wichita plant first undergo oil separation, SO₂ reduction of chromates, alkaline precipitation of heavy metals, and clarification. These treated wastes at pH 9 then pass through a contact tower packed with Intalox saddles, running countercurrent to air containing 1% ozone.

Liquid flow rate is a very brisk 20,000 lb./sq. ft./hr. Total air rate is 120 cfm. Liquid effluent from this tower is acidified to pH 7.7 via carbonization and is clarified. Then, it passes through another packed column countercurrent to the gaseous effluent from the first contact tower, which still contains some ozone.

Double pass ensures complete oxidation of cyanide to cyanate and beyond, at same time takes care of any excess SO, from the chromate reduction step.

Cyanate ion, primary product of cyanide oxidation, is 1/1,000 as toxic as cyanide. However, it is not stable. It's oxidized further to CO<sub>2</sub> and water either by the ozone or by natural processes in the oxidation lagoon.

After ozonation. cvanide content of plant effluent is nil.

Fish, flopping healthily about in the lagoon, attest to this. Even 0.025 ppm. cyanide concentration can be toxic to fish.

▶ Boeing's Hardware — Boeing uses two of Welsbach's largest ozone generators, each of which turns out 60 lb./day on air feed and double this amount on oxygen feed. Cost: about \$70,000 installed, including auxiliaries. For a capacity of 120 lb./day with air feed, ozone first costs run about \$600/lb., drop off sharply at higher capacity.

Ozonation's only significant operating cost is for the electric power to run generators, compressors, coolers and dryers, or 14-15¢/lb. of ozone.

Still another reason for the chemical processor to take another look at ozone is its availability now as a metered material delivered directly to process. When you guarantee consumption of at least 250 lb./day for a minimum of 5 yr., Welsbach will erect on-site generators and deliver the ozone on a contract price per pound without need for you to make any capital outlay. If your requirements are below this level, Welsbach will rent you the ozonators without any of the auxiliary equipment.

Daygen or Air Feed?—Use of oxygen feed doubles an ozone generator's yield and affords big savings. This suggests uses for ozone where byproduct oxygen is available or where oxygen is to be used in the process—blast furnaces, open hearths; synthesis of acrylonitrile, adiponitrile or ammonia.

Cyanide wastes occur in all these operations, save ammonia and steel making. When ammonia is a byproduct of a petroleum refinery, there are phenolic wastes to be treated. And coke-ovens give rise to phenolic effluents.

If ozone requirements exceed 1,000 lb./day, you'll find that it's worthwhile to use oxygen for feed.

► Another Field Soon—We mention phenolic wastes because here again ozone has demonstrated it possesses technical advantages over chlorine. Way back in 1950, the Ohio River Valley Water Sanitation Commission recommended ozone for

treatment of residual phenols in coke-oven wastes — recommended it over chlorine, chlorine dioxide and sodium chlorite. Nobody bought it.

But you can expect to hear soon of a major petroleum refiner putting Welsbach ozonators to work backing up a biooxidation system on phenolic wastes.

# Two More Ideas for Coal Methanation

Converting coal into a highenergy substitute for natural gas, long a favorite research project, has been winning additional attention lately.

Researchers at Columbia University, New York, N. Y., are applying atomic radiation to the hydrogenation reaction trying for a methane-rich gas. Coal is heated with hydrogen under high pressure and exposed to radiation from a 20-lb., 1,400-curie chunk of cobalt 60. Radiation helps decompose the coal and catalyzes hydrogenation reaction.

Although tests are just getting underway, preliminary results indicate that radiation-hydrogenation method can yield mostly methane gas, little ash.

► Australian Approach—Meanwhile, down-under experimenters are working on a fluidized-bed hydrogenation process that would convert Australia's large browncoal deposits into "natural" gas.

In experiments at Commonwealth Scientific and Industrial Research Organization, coal particles are suspended in a hydrogen stream and fed continuously into reactor. Test reactor, 3 in. dia. and 39 in. high, operates between 300-600 psi. and 900-1,550 F. Hydrogen feed range is 20-140 cu. ft./lb. of coal.

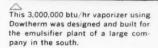
Maximum methane yield obtained to date is 10.1 cu. ft./lb. of coal at 75% gasification. Major problem: As methane yield increases, gasification percentage goes down. Researchers believe longer particle residence time is the way over this hurdle and are redesigning reactor.

And back in this country, Institute of Gas Technology, Chicago, is also working on a coal gasification program (see *Chem. Eng.*, Oct. 1957, p. 164).

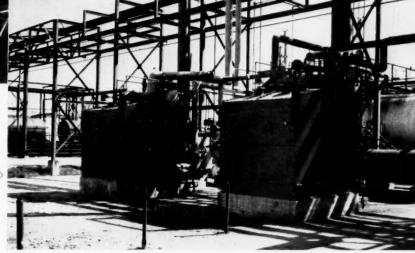
<sup>\*</sup> The Ohlo River Valley Water Sanitation Commission recently proposed legislation setting limits on chloride content of plant effluents for various stream flow levels. Chlorination of cyanide produces from 8 to 15 parts chloride for each part cyanide eliminated.

# INDOORS or OUT ...

# FW Vaporizers using Dowtherm\* CUT COSTS of <u>high-temperature</u>, <u>low-pressure heating</u>



Two vaporizers using Dowtherm at a large industrial chemicals plant each supply 2,200,000 btu/hr, 650F, 58 psi for process heating.



# ... BECAUSE ONLY FW DOES THE COMPLETE JOB

\*Design and Engineering. High temperature, low-pressure heating systems by Foster Wheeler are specially designed and engineered to meet your specific process requirements to best advantage.

\*Installation. Foster Wheeler can supply and install the complete heating system — making sure that every detail of the installation is right for the job.

\*Operation. Foster Wheeler responsibility follows through to the successful operation of the entire system. *Proper functioning* of all elements is positively assured.

**Service.** Foster Wheeler's skilled engineers and service personnel are *available at all times*—to assure continued trouble-free operation or to assist in any process changes or relocation of equipment.

FOR 24 YEARS Foster Wheeler engineers have been designing and applying process heating systems using Dowtherm. These applications—over 500 of them—have been supplied with oil, gas or electrically heated units in capacities from 44,500 to 50,000,000 btu/hr and are operating at temperatures of approximately 500 to 720 F and pressures of approximately 1 to 113 psig. In every instance, the vaporizer unit was recommended only after the entire process heating system had been analyzed. This was the customer's assurance of a vaporizer that's right for the job.

We will be glad to study your requirements and point out how FW high-temperature, low-pressure heating systems will improve your process. For complete information, write for Bulletin ID-54-5. Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, N. Y.

\*Reg. Trade Mark, Dow Chemical Co.

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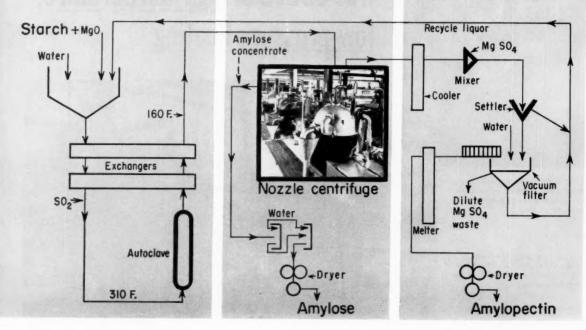
NEW YORK . LONDON . PARIS . ST. CATHARINES, ONT.

# To Fractionate Starch, Three Process Stages...

DISPERSE amylose and amylopectin by cooking starch in MgSO<sub>4</sub> solution.

SEPARATE amylose by cooling below 200 F. and centrifuging suspension.

SALT OUT amylopectin by cooling, adding more MgSO<sub>4</sub> and filtering.



# Starch Process Nudges Genetics to Sidelines

Smart process engineering beats plant genetics in race to produce amylose. Previously sought from highamylose starch, it's now wrung from potatoes.

An on-target thrust by Dutch chemical engineers has split apart the previously inseparable starch components, amylose and amylopectin. Following up their initial penetration, these men have brought on stream at Avebe, Veendam, The Netherlands,\* the first successful, commercial starch fractionation.

► Salty Potatoes—Process uses potato starch containing 22% of the linear, cellulose-like amylose

\*Developed with help of the National Council for Industrial Research, Delft, the Avebe (Coop. Verkoop-en Produktievereniging van Aardappelmeel en Derivaten) process is covered by U. S. 2,325,698 and 2,429,104 patents.

and 78% of the glycogen-like branched amylopectin polymer. Through use of a closely controlled magnesium sulfate medium, Avebe disperses the starch components at high temperature without degradation, then differentially agglomerates the amylose and amylopectin fractions by step cooling and adjustment of salt concentration.

Output of the plant has reached 35,000 lb./day of amylopectin and 12,000 lb./day of amylose. Both materials are available in the U. S. through

Stein Hall & Co., of New York.

Amylose, which is offered in commercial quantities for the first time anywhere, can be made into edible films with potential use for food packaging and casings. It adds strength, water resistance and grease resistance to paper.

Amylopectin is already used in textile sizing and finishing to strengthen fibers, prevent fuzziness. In foods like soup and pie fillings, it's used as a thickening and suspending agent.

► Engineering Replaces Breeding—Before Avebe could come up with its successful fractionation process, it had to solve a self-perpetuating chain of chemical engineering problems. Only through biological upgrading have previous developers



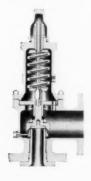
# **CORRUGATED SLEEVE**

# shields working parts

A durable, two-ply stainless steel Sealing Bellows in Consolidated Safety Relief Valves isolates contaminants, corrosion or viscous fluids from the working parts. The Bellows is balanced with the seating surface. Capacity is less affected by variable back pressure, so you can use smaller discharge piping and reduce the cost of pressure-relieving systems.

Full-rated relieving capacity is certain at all positions of the single blowdown adjusting ring because a fixed maximum secondary orifice provides full lift at 10% overpressure. Even with superimposed back pressure in the relieving system, valve action is consistently positive.

Protection of working parts is but one of many reasons why Bellows Type Consolidated Safety Relief Valves assure absolute protection for personnel and facilities. Write for details, including facts about the Standard valve that you can convert to the Bellows type in your own shop. Ask for Catalog 1900.





CONSOLIDATED SAFETY RELIEF VALVES

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Tulsa, Oklahoma In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario been able to produce either of these starch constituents in

pure form.

For instance, corn bred to contain from 97-99% amylopectin has been the raw material for production of amylopectin by companies such as National Starch Products and American Maize products. And a new kind of corn with a high amylose content is under study at the Peoria, Ill., laboratory of the Agricultural Research Service, U. S. Dept. of Agriculture.

► Disperse Without Degrading
—First problem Avebe faced
was to disperse the closely interrelated amylose and amylopectin existing in the starch.

Heat does the job. But with starch, too much heat degrades the molecules. Also, during heating, hydrolysis and oxidation caused by air dissolved in the solution water may further de-

grade the starch.

Avebe's answer to these problems requires use of a 13% solution of magnesium sulfate as a dispersion medium. By autoclaving starch in this solution for 15 min. at 310 F.—a high temperature in the field of starch chemistry—Avebe produces better results than with lower temperatures for longer intervals. And the salt solution alters gelatinization of the starch the desired amount.

► Must Control Oxygen—To forestall hydrolysis and oxidation, Avebe holds pH constant by adding small quantities of magnesium oxide and sulfur dioxide. Quantity of magnesium oxide is fixed, while the amount of gaseous sulfur dioxide is regulated through a gas flowmeter to maintain pH 7.

► Feed Enters Through Heaters
—Incoming feed slurry contains
a starch to mother liquor weight
ratio of 1:10. With the plant
scheduled to produce 1 ton/hr.
of fractionated starch, 11 tons
of material must be heated and

cooled every hour.

In order to minimize molecular degradation, heating and cooling are kept within 10-min. time spans. Incoming slurry passes through shell and tube heat exchangers to pick up part of its required heat from a counterflowing stream of hot dispersed starch which must be

cooled. Steam heaters compensate for thermal losses, thereby boosting slurry to autoclaving

temperature.

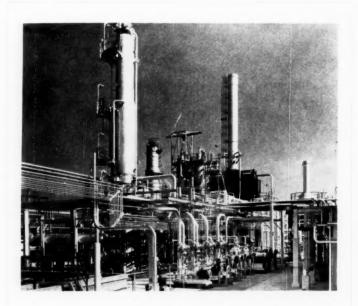
First, Remove Amylose—After the required 15-min. retention in the autoclave, material is cooled below 200 F. causing the amylose fraction to agglomerate into 1- to 50-micron spherical particles. Because density of these agglomerates is very close to the density of the equilibrium liquid, process requires two centrifuging steps to recover the amylose.

First, slurry passes through nozzle centrifuges which concentrate the amylose slurry and discharge essentially clear amylopectin solution. Amylose concentrate at 160 F. feeds into basket centrifugals for final dewatering and washing until free of amylopectin and magnesium sulfate. Thick paste from the

centrifugals goes through drum dryer, grinder and finally to bag packer.

Amylopectin Last—Amylopectin solution from the centrifuges is cooled to room temperature and dosed in a flow mixer with metered quantities of saturated magnesium sulfate solution which raises MgSO<sub>4</sub> concentration of medium to 14%. Amylopectin flocculate formed by this dosing must then ripen in the 14% solution of magnesium sulfate to become insoluble in cold water. Then, it can be filtered and washed on vacuum filter.

Pure cake from the vacuum filter may then regain the cold water solubility required in the final product by undergoing heating so that it dissolves in its adhering rinse water. Drum drying this solution produces final pure amylopectin product.

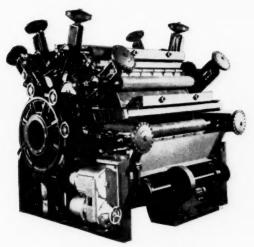


# U. S.-Built Unit Gives Twist to French Refinery

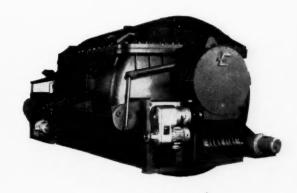
New desulfurizer at Compagnie Francaise de Raffinage's Provence refinery, Martigues, France, incorporates some process twists to make it more efficient and versatile. Two-reactor system (between towers)

can process gas oil, kerosene or naphtha. Unit separates effluent by progressive flash-and-recycle gasoline absorption which permits higher percentage of recycle hydrogen to reactor sys-

# PROFIT FROM EIMCO "TAILORED TO FIT" FILTERS



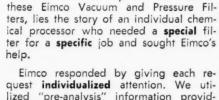
EIMCO CONTINUOUS BICARB WHEEL Filters in Soda Ash Process (Uses 3, 4 and 5 press rolls)



EIMCO PRESSURE DRUM WITH REPULPER Handles flammable material



EIMCO VACUUM PRECOAT Filters a yeast liquor



Behind the development of each of

quest individualized attention. We utilized "pre-analysis" information provided by competent Eimco Sales Engineers; complete, modern test facilities and data at the Eimco Research and Development Center, and know how and experience of skilled Eimco Technologists.

Eimco has discovered many new influencing factors in vacuum and pressure filtration, important to the **total** economic picture. A particular vacuum advantage may be offset by a more profitable pressure advantage, elsewhere (or viœ versa). Eimco balances these advantages to assure you the most profitable equipment selection from a realistic investment-operating cost standpoint.

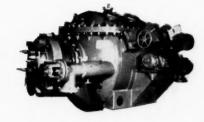
Because **custom design** calls for a high degree of specialization, it is important that you begin by talking over your problem with an Eimco Representative. Let us arrange this meeting at your convenience.



EIMCO PRESSURE DRUM Deashes coal tar



EIMCO CONTINUOUS VACUUM DRUM Handles an acrylic polymer slurry



EIMCO PRESSURE DEWATERER Filters for a Phenol, Acetone and Alphamethyl Styrene Producer

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# mole Trails seed to Better Performance

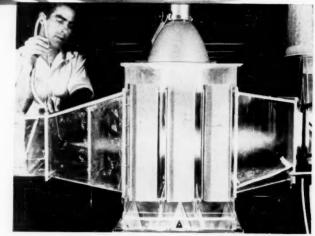
# **Electrostatic Collector and Flues**

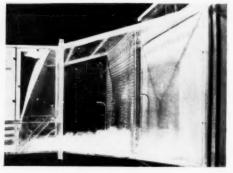
Engineer shows how smoke travels uniformly through precipitator.

# **Original Inlet Deflects Flow**

Angle of heater floor directs smoke into turbulent flow pattern, leaving void.







Revamped Inlet Smooths Out Flow Straightened passage cuts turbulence, perforated plate in flue redirects flow.

# Transparent Models Crack Gas-Flow Mysteries

Equipment engineers find that plastic models reveal answers to gas-flow problems.

Engineers at Research-Cottrell, Bound Brook, N. J., now use transparent plastic models as a powerful tool to show how flue gas flows through specific industrial systems. Results to date, with models of a dozen different systems, prove that the method pays off.

In Research-Cottrell's case, engineers have used the models

to upgrade performance of existing electrostatic precipitators so that they remove suspended matter more completely from gas streams, or handle higher flows. And on new installations, they have been able to reduce equipment size because they no longer need the large safety factor as a cushion against unsuspected turbulence.

But, the technique certainly isn't limited to upgrading precipitators, despite the fact that Research-Cottrell seems to be the first to apply it to study of industrial gas flows. By noting how Research-Cottrell has prof-

ited, others may be able to improve gas-handling operations. ► New View of Flow—From their experience with gas flow through electrostatic precipitators, R-C engineers know that flue-system configuration controls uniformity of flow through the precipitator. In turn, this determines distribution of dust loading in the stream and the efficiency of precipitator operation.

Generally speaking, when engineers discover unsatisfactory flow conditions in gas ducts or flues, they are forced to "cut-and-try" on the operating equip-

# new chemical plant

# DESIGNED AND BUILT IN JUST SIX MONTHS

Undivided responsibility for engineering, procurement and construction services enabled CATALYTIC to build a new, operating chemical plant in just six months!

This unique performance called

for precise coordination between the client and the contractor-to CATALYTIC, this project was a welcome opportunity to meet the challenge of on-time, on-budget performance . . . to show SKILL, EXPERIENCE and IMAGINATION at work.



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ment in order to smooth out flow. That's because flow conditions are too complicated to be solved with basic flow equations.

Now, however, by observing how gas flows through a Plexiglas model of their system, R-C engineers can see existing conditions. Here is where they determine what, if anything, they must do to change these conditions. Here, on the small model, is where they can "cutand-try" to their hearts' content until they feel they've reached optimum performance. Then, they can incorporate their findings in commercial equipment with good assurance of success. ► Making Models—When Cottrell or a customer has a problem that warrants a model study, an engineer in the model shop scales drawings of the commercial unit down to 16 actual size. All measurements are to 16-in. tolerance.

Four craftsmen cut parts from 18-in. Plexiglas sheet and join them with cement, making gas-tight joints. Internal parts such as turning vanes, flow splitters and precipitator electrodes are simulated in sheet

metal.

Six to eight weeks after drawings are prepared, model is ready for testing. To simulate gas flow, a 25-hp., 5,000 cfm. (at 21-in. w.g.) fan sucks air

through the system.

For most studies, injection of smoke into the air stream shows flow patterns (see illustrations). Titanium tetrachloride vapor contacting moist room air generates dense white smoke that works very well. Other materials such as threads, ribbons. ground cork or dust also reveal flow patterns.

► Mapping Gas Flow—On initial testing, visual observations alone usually show up areas of no-flow, turbulence and eddying. Then, the engineer changes flue configuration and notes whether or not it improves the flow pattern. If successful, he charts a gas velocity profile for different sections of the model.

To get data for velocity profile, engineer inserts instruments into model through small holes drilled in Plexiglas. At low gas velocities (10 ft./sec.)

he uses a thermal anemometer: at higher velocities he gets more accurate data with a small nitot tube.

Distribution of dust in the gas (air) flowing through the precipitator section can charted quantitatively from the pickup on pieces of Scotch tape fastened to the simulated electrodes. A photoelectric cell will indicate accurately the relative concentration of dust on the

tape strips.

▶ Proof of the Pudding-Results obtained with models have correlated quite well with performance of corresponding commercial unit. Good agreement is obtained, even though Reynolds number in full-scale installation is not duplicated in

As long as gas flow in model is above critical Reynolds number, performance will duplicate full-scale gas flow. That's because flow disturbances come from shock patterns caused by sharp changes in flue cross section or shape, rather than from

friction losses.

These same shock patterns are major contributors to pressure drop. Models have shown how to cut pressure drop across a system 1-to 1-in. water. It's estimated that each inch of pressure drop costs \$40,000-\$80,000 for fans and motors, so savings in this area are considerable.

Too, model studies show that certain components (e.g. dropout hoppers) often can be left out of the system with resultant savings. Precipitator design itself has benefited; baffles previously used to correct gas flow are now unnecessary, lowering cost and pressure drop.

▶ Drop in the Bucket—And the cost? A mere trifle, in terms of over-all expense. Research-Cottrell reports that its models cost only 1-2% of the installed cost of the precipitation system; savings run eight to 10 times this amount, now make model studies standard procedure for many jobs.

Such was not always true. In several instances, Cottrell engineers spent several months in the field trying to work out the bugs in a precipitator installation before finally calling for a

model study to pinpoint the trouble. In every case, once the model was built, it took little time to find and correct the difficulty.

#### **News Briefs**

Solid propellant: Pennsalt Chemical Corp., on completion of an \$800,000 expansion at its Portland, Ore., plant in about five months, will start production of ammonium perchlorate for solid propellant use in missiles.

Propane: Texas Natural Gaso-line Corp. and Tennessee Gas Transmission Co. have contracted with Fluor Corp. to build a 150-million-cfd. processing plant to strip propane from natural gas near New Orleans, La. Due on stream Nov., this year, plant will cost over \$3 million.

#### Convention Calendar

American Power Conference, 20th anniversary meeting, Hotel Sherman, Chicago, Ill., March 26-28.

Instrument Society of America, New Jersey Section, 10th annual symposium, Control Systems Engineering, Hotel Essex House, Newark, N. J., April 1.

American Institute of Chemical Engineers, Philadelphia-Wil-mington section, all-day meeting, Scale-up in Practice, University Museum, University of Pennsylvania Campus, Philadelphia, Pa., April 8.

Fifth Annual Conference on Accident-Prevention Engineering, University of Florida campus, Gainesville, Fla.. April 9-11.

American Chemical Society, 133rd national meeting, San Francisco, general assembly— April 14, Nourse Auditorium, San Francisco, Calif., April 13-18.

Design Engineering Show, International Amphitheatre, Chicago, Ill., April 14-17.



Fourteen basic coil sizes are available to give you optimum (most favorable) selection for either steam or hot water; up to 200 PSIG from 100,000 to 4,000,000 BTU/hr; air capacity for effective circulation, 2,000 to 34,000 CFM.

Sturdy casings, heavy-duty bearings and Westinghouse proven-plate fin-coil construction and performance give you a product to meet your most exacting application requirements.

You can't buy more rugged *quality* and *versatility* than is built into the Westinghouse line of unit heaters, designed *exclusively* for industrial applications.

Further, compact Westinghouse units can be mounted on the floor, wall or ceiling, can be relocated to accommodate changes in plant layout. And every unit is backed by a Westinghouse exclusive—one warrantyfor engineering assistance and single equipment responsibility.

Next time you buy or specify Industrial Unit Heaters, call your Sturtevant Division Sales Engineer. For your copy of Industrial Heater Catalog 1510-2, call him now or write Westinghouse Electric Corporation, Dept. A-5, Hyde Park, Boston 36, Massachusetts.

You can be SURE...IF IT'S
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# CHEMICAL PRODUCTS EDITED BY FRANCES ARNE

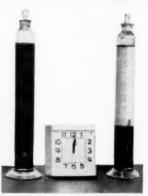


# Faster Settling Via New Flocculant Can Cut Equipment Size, Cost

Newethylene oxide polymer, 11 ppm., is mixed in 25% coal solids slurry.

In 1 min., 15 sec., treated slurry is settling, untreated is unchanged.

In 1 ½ min., mass is filterable. With speedup, thickener area needs go down.



# High-Order Flocculant Activity Spans Wide pH

Lab tests show effectiveness in alkaline, neutral and acid systems that may give new polymer an edge over most flocculants in mining, metallurgical markets.

A new member is joining the band of synthetic organic flocculants which in the past three to five years have carved a \$3-million market for themselves in mining and metallurgy. Improving flocculating activity in the order of 10 to several hundred fold, they owe the bulk of their growth to the major scaleup in refining uranium ore.

But the new flocculant, called Polyox coagulant, claims this high order of effectiveness over a wide pH range. With few exceptions, synthetics have been limited to neutral or alkaline systems: Dow's flocculant Separan 2610—now dominating the

uranium-processing market—has been used successfully in alkaline, neutral and acid systems. American Cyanamid's new Reagent S-3171 shows promise of matching Separan's universality.

Both Dow and Cyanamid products are high molecular weight polyacrylamides. Polyox coagulant is a high-molecular weight grade of Union Carbide Chemicals' new family of Polyox water-soluble resins, the latest product in this unusual class of ethylene oxide polymers to reach the market. Carbide reports that the effectiveness of its new flocculant over a wide pH

range has already been demonstrated in a number of systems, including uranium ore slimes, silica suspensions, coal washery and other carbonaceous slurries, and clay suspensions.

The new coagulant is also said to show remarkable ability to coagulate polymeric dispersions of organic materials. For example, it coagulates many types of synthetic latices prepared by emulsion polymerization for use in the manufacture of synthetic fibres and synthetic elastomers. Aqueous dispersions of natural latices can also be effectively coagulated with the new material.

Polyox flocculant is now available in development quantities as white, crystalline granules. — Union Carbide Chemicals Co., 30 East 42nd St., New York, N. Y.



Boron Trifluoride
Hydrofluoric Acid
ANHYDROUS...AQUEOUS

The uses for Fluorides are ever increasing. Harshaw Fluoride production also has increased steadily. Shipments of cylinders, tank trucks and tank cars leave our plant daily. If required, you are invited to draw on the knowledge and experience of our staff of technical specialists on Fluorides.

### THE HARSHAW CHEMICAL CO.

1945 EAST 97th STREET . CLEVELAND 6, OHIO

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Write for your free copy of M.C.A. Chemical Safety Data Sheet SD-25 on properties and essential information about...

HYDROFLUORIC ACID
Anhydrous and Aqueous

# Here is a helpful list of HARSHAW production-controlled high-quality fluorides:

Ammonium Bifluoride
Ammonium Fluoborate
Antimony Trifluoride Sublimed
Barium Fluoride
Bismuth Fluoride
Boron Trifluoride
Boron Trifluoride
Complexes
Chromium Fluoride
Copper Fluoborate

Fluoboric Acid
Fluorine Cells
Fluorinating Agents
Frosting Mixtures
Hydrofluoric Acid Anhydrous
Hydrofluoric Acid Aqueous
Hydrofluosilicic Acid
Lead Fluoborate
Metallic Fluoborates
Potassium Bifluoride

Potassium Chromium Fluoride
Potassium Fluoborate
Potassium Fluoride
Potassium Titanium Fluoride
Silico Fluorides
Sodium Fluoborate
Tin Fluoborate
Zinc Fluoride



To make low-cost tooling for metal forming, liquid resin lines flat pan.



Placed in 300 F. oven, resin impregnates dried steel powder preform.

### Steel-and-Epoxy Resin

Two-component punch-anddie material cuts costs of short-run tooling by 85%.

A new two-component (steel and epoxy-type resin) punchand-die material—3M brand tooling compound 113—has been developed for use in place of expensive machined metal tools for prototype or short-run draws of difficult shapes.

In simpler metal-forming, tools made of the compound can be used for production runs in the thousands of pieces.

The compound is more than 90% steel. This gives it the compression strength (22-26,000 psi.), impact strength (0.4 ft. lbs./in. of notch), abrasive resistance, and machineability necessary for standard press set-up and running operations.

Its thermal conductivity (0.6 Btu./hr. sq. ft. deg.-F./ft.) prevents heat-up during drawing operations, while indications are its electrical conductivity poses, for most practical purposes, only a minor resistance as compared with steel.

Eliminated are the mixing, weighing, and pot-life problems often associated with the usual plastic tooling materials. The

Page number is also Reader Service Code Number

Ethylene-oxide-based flocculant works over wide pH	74A
Steel-and-epoxy resin can cut costs of tooling	
Anti-stripping agent adds to asphalt's weather resistance	76B
Acrylic paint emulsion fits many color systems	76C
PVC resin in larger particle size has handling benefits	78A
Epoxy resin is water white, not conventional yellow	78B
Polyester laminating film seals without adhesive	78C
Herbicide promises low-cost control of deep-rooted weeds	78D

3M compound permits one-step fabrication of large pieces, no special equipment required.

Components are a treated metal powder that can be formed into shapes with good dimensional stability and a thermosetting epoxy-type liquid impregnating resin.—Minnesota Mining & Mfg. Co., St., Paul, Minn. 76A



### Anti-Stripping Agent

Stones coated with treated asphalt, right, aren't stripped by 24-hr. immersion.

The cationic surface active additive, called Redicotes, have been developed to make road paving possible irrespective of weather.

Redicote-treated asphalt will bond to hydrophilic aggregate even in the presence of water. These cationic chemicals also have a strong affinity for either acidic or basic stones. They are effective in concentrations as low as 0.3 to 0.5% of the weight of the asphalt.

Photo above shows the results of 24-hr. immersion in distilled water of treated (right) vs. untreated asphalt-coated stones. —Armour Chemical Div., Chicago, III. 76B

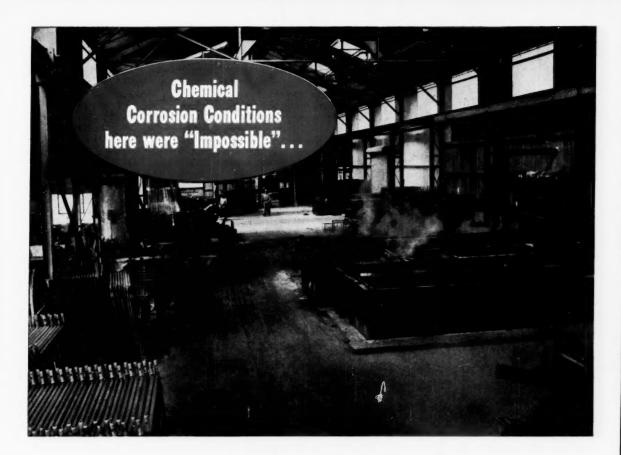
#### **Aerylie Paint Emulsion**

Compatible with a wide range of color systems.

A new acrylic latex for paint manufacture contains essentially the same acrylic polymer as the company's standard acrylic emulsion, Rhoplex AC-33, but it is supplied at lower viscosity and higher solids (55% vs. 46%). Called Rhoplex-55, it sells at a slightly lower price on a solids basis and offers greater compatibility with various color tube systems.

The new compound and the standard are both 100% acrylic polymers. However, the emulsifying system of the new Rhoplex AC-55 is different. It provides a wider acceptance of aqueous tinting colors and difficult-to-disperse tube colorants. It is produced in an anionic emulsifying system and is lower in viscosity than the standard emulsion.

These differences are said to offer the paint chemist even wider latitude than previously in the formulation of durable, color retentive interior and exterior coatings. The new emulsion can be adapted to most acrylic formulations by a simple adjustment of thickener and water content.—Rohm & Haas Co., Washington Sq., Philadelphia, Pa. 76C



# **But TARSET®** Stopped the Attack!

The extreme corrosion conditions found in this metal finishing plant are seldom surpassed! Pickling and plating equipment, as well as structural steel, is under constant attack from fumes and spillage of sulphuric, nitric and chromic acids and cadmium and zinc salts. After several other protective materials failed, Pitt Chem Tarset was applied and stopped corrosion in its tracks.

No other protective coating on the market today offers you the broad corrosion-resisting

properties and relatively low cost of this unique and patented Coal Tar-Epoxy Resin coating.

Wherever the going is roughest—on storage tanks, precipitator tanks, material conveyors and similar chemical plant equipment—you'll find *Tarset* is the recommended coating.

If you have a stubborn corrosion problem that you've labeled as economically "impossible" to control, it will pay you to investigate *Tarset*. Send today for complete technical data and samples for testing.

think First

of the Coatings

that Last!

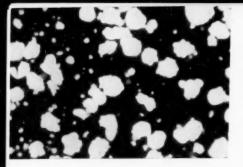
PITT CHEM
"Insul-Mastic" Gilsonite Coatings

PITT CHEM
"Tarset" Coal Tar
Epoxy Coating

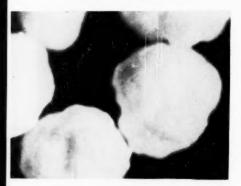
PITT CHEM Industrial Coatings are available through leading Industrial Distributors. See the "Yellow Pages."



COAL CHEMICALS . PROTECTIVE COATINGS . PLASTICIZERS . ACTIVATED CARBON . COKE . CEMENT . PIG IRON



Large uniform particle size marks new polymer, below. Usual resin is smaller, with fines, above.



**PVC** Resin

Resembling white porous pearls, it can absorb more plasticizer.

A new process for the polymerization of vinyl chloride has been developed. Product, called Escambia PVC Pearls, has a large, uniform particle size, is completely free from fines.

Vinyl chloride is usually polymerized either as an emulsion or a suspension in water, and the new polymerization process is in the latter class. In general, manufacturers prefer suspension polymerization formulations for applications which require superior color, clarity, heat resistance and electrical properties.

However the suspension systems usually produce a polymer having a broad particle size distribution, ranging from dust-like particles of several microms to large particle of several hundred microns. Absence of very small particles or fines in the new Pearl polymer eliminates such problems as dust and reduces material loss in storage and processing.

An acceptable PVC resin is capable of absorbing a required amount of plasticizer and yields a free-flowing powder on heating. The dry blend must also CHEMICALS . . . .

possess sufficient dryness to flow through hoppers or be blown through a conveying system without caking or interfering with processing.

PVC pearls, compared here with two of the best commercial resins, are superior on the basis of plasticizer absorption capacity and flow:

	Time-	Dry Blend Flow Rate Gm./Sec.
150 Pts. DOP/ Hundred PVC Pearls	180	3.4
100 pts. DOP/ Hundred Resin A	100+	Will not flow
100 Pts. DOP/ Hundred PVC Pearls	14	4.0
50 Pts. DOP/ Hundred Resin B	5	Will not flow
50 Pts. DOP/ Hundred PVC Pearls	3	6.2

Not only with DOP but with polymeric plasticizers, the pearls' capacity for high plasticizer levels and flow rates of resulting dry blends are outstanding. The large uniform particle size is probably responsible for flow properties, as there are no fines to pack between the large particles.

Also, the larger size presents a smaller surface for particleto-particle contact and adhesion, yielding superior flow rates at all plasticizer levels.

Four types of the PVC Pearls are commercially available: types 2250, 2225, 2200 and 2185 representing high, medium, low and very low molecular weight respectively.—Escambia Chemical Corp., 261 Madison Ave., New York, N. Y. 78A



**Epoxy Resin** 

Liquid is water white instead of conventional yellow.

The water white clarity of a new liquid epoxy resin is expected to open new fields for epoxies where full advantage of their toughness and corrosion resistance could not be taken because of the yellow or amber color of conventional resins.

Called D.E.R. 332, the product is the monomeric diglycidylether of Bisphenol-A rather than a conventional mixture of polymers. Uses will be in laminating and electrical encapsulating where low viscosity and uniformity are required.

Simultaneously, the company has announced two other liquid epoxies: D.E.R. 331, a standard unmodified resin suitable for use in tooling, casting, adhesives; D.E.R. 334, a modified low viscosity resin especially suited for laminating.—Dow Chemical Co., Midland, Mich.

78B

#### BRIEFS

Polyester laminating film called Videne is now in limited production; commercial quantities will be available early next year. It differs from other plastics in its ability to adhere under heat and pressure to textiles, metals, wood, paper and certain plastics without adhesives and will vacuum form or draw to the limits of supporting materials. It is an unoriented, amorphous, thermoplastic material which cannot be crystallized. Reports are that a fibre from the product may also be forthcoming. - Goodyear Tire & Rubber Co., Akron, Ohio.

Herbicidal compounds based on 2, 3, 6-trichlorobenzoic acid are now being produced commercially. They show promise for control of bindweed and other deep-rooted perennial weeds at reasonable cost.—
Heyden Newport Chemical Corp., New York, N. Y. 78D

#### For More Information . . .

about any item in this department, circle its code number on the

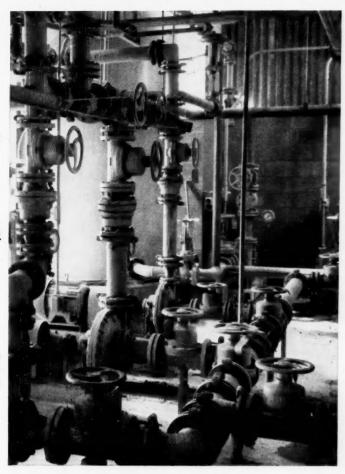
#### Reader Service

postcard (p. 187)

Maintaining

<u>maximum</u> flow
in serum lines
with <u>minimum</u>
pressure drop

Goodyear Tire & Rubber Company reports no valve clogging or interruption to flow in handling viscous fluids — with Grinnell-Saunders Straightway Diaphragm Valves.



Grinnell-Saunders Straightway Valves are now in use on serum lines of the Goodyear Tire & Rubber Company. Serum is a suspension of rubber particles in an acid brine solution. The installation pictured above is in Goodyear's Synthetic Rubber plant at Houston, Texas.

Grinnell-Saunders Straightway Valves were selected for this service because of their straight-through design. Material in process cannot build up and choke off flow because there are no pockets or gate trenches to trap solids. The straight-through feature also assures speed, ease and economy of rodding out, when necessary. When a diaphragm must be replaced — that job, too, can be done quickly, without removing the valve body from the line.

Isolation of operating parts from the fluid stream is still another important advantage of the Grinnell valve ... eliminating corrosion and clogging of the valve mechanism while, at the same time, preventing contamination of product in the line.

Grinnell-Saunders Diaphragm Valves are available in a wide range of body, lining, and diaphragm materials to meet different service conditions. To secure further information, contact the Grinnell branch office nearest you — or write directly to Grinnell Company, Inc., 277 West Exchange Street, Providence, R. I.



Diaphragm lifts high for streamlined flow in either direction. No irregular surface to trap deposits.



Diaphragm presses tight for positive closure, even when handling viscous or fibrous materials.

# GRINNELL-SAUNDERS DIAPHRAGM VALVES



Grinnell Company, Inc., Providence, Rhode Island

Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings \* welding fittings \* engineered pipe hangers and supports \* Thermolier unit heaters \* valves Grinnell-Saunders diaphragm valves \* pipe \* prefabricated piping \* plumbing and heating specialties \* water works supplies industrial supplies \* Grinnell automatic sprinkler fire protection systems \* Amco air conditioning systems DEVELOPMENTS ...

# PROCESS EQUIPMENT EDITED BY C. C. VAN SOYE

# **Equipment Developments**

Page number is also Reader Service Code Number

#### Metallic Insulation Routs Heat Loss...80A



"Air sandwich" bars heat transfer by either radiation or conduction.

### Steel Drums That Need No Pallets . . . . 82B



New rolling hoop, designed to interlock adjacent drums cuts handling costs.

#### Recording Balance Charts Weight . . . 80B



May be of great value in various fields of research and control.

### Magnetic Separator Traps Iron.....82C



Steel cylinder fully encloses permanent magnets creating rotating field.

### 

For more details use Reader Service Card

#### Metal Insulation

New product utilizes reflective principle.

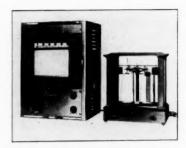
A new prefabricated product, consisting of several widely spaced, thin, reflective metal sheets welded together to form an "air sandwich", insulates effectively from -400 to 2,000 F. Dubbed "Mirror Insulation" by its producers, the new prod-

uct bars heat transfer by either radiation or conduction.

Light weight facilitates handling and installation. In addition, the product's integral outer case of heavy-gage metal gives rise to many desirable properties. Among these are durability, washability, non-absorbency and attractiveness.

Steel bands, sheet metal screws, or snap latches secure the insulating units to plant lines and equipment.

The manufacturer offers insulation in many sizes for pipes, ducts, fittings, vessels and other equipment. Standard material of construction for temperatures from -100 to 1,000 F. is aluminum. Steel and special alloys extend this range if required.—Mirror Insulation Co., Inc., 201 South Main St., Lambertville, N. J. 80A

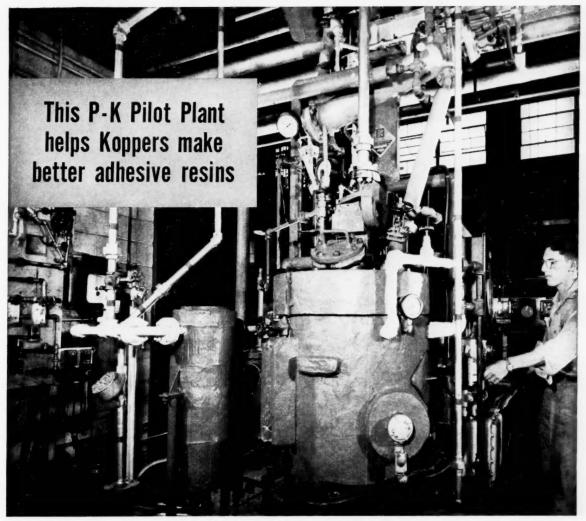


#### Recording Balance

Analytical balance shows rate of weight change.

An automatic analytical balance that continuously records instantaneous weight and rate of weight change promises new advances in the fields of research and control.

The balance should prove most valuable for obtaining



Technician checks pilot run of new Resorcinol resin at Koppers Verona (Pa.) Research Center. 15-gal. P-K Pilot Plant includes reactor, vapor reflux pipe, condenser, decanter, receiver, controls.

Resins, like many chemical products, are difficult to scale up from laboratory to plant production. Formulas must be painstakingly adjusted until the product of the reaction kettle is identical with that of the laboratory flash

Koppers solved this problem of scale-up—and a lot of others, too—by installing a P-K Packaged Pilot Plant at its Verona Research Center.

This versatile unit determines production variables on new adhesive resin formulations with a minimum of cost and time. And, because it's a P-K *Packaged* Pilot Plant, Koppers even saved money and time before the unit made its first run — on design, engineering and delivery.

P-K Pilot Plants are made in 5 to 60 gallon capacities.

Design can be modified to meet special requirements, and larger sizes can be built.

These units speed *your* product development work in many ways. For example, the smaller plants are ideal for testing and sampling. Larger sizes can even be used for small production runs. In addition to helping you determine scale-up factors from lab to plant, a P-K pilot unit is a tool to find engineering design data for new processes...determine costs...define changes in existing processes to reduce costs...improve quality control procedures.

If there's a new product in your future, get the full story of P-K Packaged Pilot Plants. Just write to The Patterson-Kelley Co., Inc., 1503P Hanson Street, East Stroudsburg, Pa.



P-K "Twin-Shell" Blenders • Heat Exchangers • Packaged Pilot Plants • P-K Lever-Lock Doors • P-K Vacuum Dryer Blenders



### Vacuum + Induction Heating = Better Alloys

This production-size, vacuum induction furnace has the lead role in Battelle's research program aimed at improved alloys and high-quality castings. Recently installed in their metallurgical lab, the new tool can

melt from 10 to 300 lb. of metal at vacuums down to 1 micron. The externally cooled, steel vacuum-chamber houses either a centrifugal casting machine or a turntable.—Battelle Memorial Inst., Columbus, Ohio. 82A

weight-temperature-time data. Evaporation, absorption, corrosion and decomposition studies fall under this heading.

Samples are placed either on the balance pan or in a controlled atmosphere above or below it. During automatic operation, a recorder graphs sample weight changes linearly.

Each sweep of the pen across the width of the 11-in. chart represents 110 mg. The balance automatically adds or removes weight, as needed, to rescale the recorder pen after each 110-mg. gain or loss. Range of automatic weight control is 4 gm.

Balance capacity is 200 gm.; accuracy and readability are 0.1 mg.—Wm. Ainsworth & Sons, Inc., Denver 5, Colo. 80B



Steel Drum

New rolling hoops save space, eliminate pallets.

Unique design of the rolling hoops on Vulcan's new 55-gal. drums promises to do away with drum palletization. In addition, groups of the new Uni-Drum containers pack together more closely, resulting in some space savings.

The rolling hoops are slightly offset—alternately raised and lowered—on opposite sides of the drum. When a group of drums is unitized, the hoops of each drum interlock with those of the others around it.

Once unitized and strapped, a group of the containers lends itself readily to transport via standard lift trucks, without benefit of pallet.

Costing no more than conventional 55-gal. drums, the Uni-Drum comes with a variety of closures, linings, accessories and fittings.—Vulcan Containers, Inc., P. O. Box 161, Bell-wood, Ill. 82B



#### **Magnetic Separator**

Rotating-field device has no exposed moving parts.

Novel design of this recently developed separator permits clean extraction of magnetic materials from non-magnetics.

The machine, primarily intended for use in mineral beneficiation, also traps tramp iron and other magnetics in foodstuffs, seeds, chemicals and other granular materials.

Permanent magnets, revolving within a stainless steel cylinder, create the rotating field. Separator design permits multiple stacking, either in series or in parallel. This allows a choice between degree of separation and throughput.

Effective field lengths of industrial models are either 18 in. or 36 in. A lab size with a 6-in. field is also available. Horsepower requirements for all models are very low.—Carpco Mfg., Inc., Jacksonville 6, Fla.

32C



Some of the many available desiceant.

# It takes an expert prescription to dry gas properly . . .

# Come to Kemp



Kemp Oriad Dryer protects pneumatic instrument board at Spencer Chemical in Charlestown, Ind. The unit has needed only minor service since its installation in 1950 and has given top performance at all times.

Over 20 different desiccants . . . each with its own particular properties and uses. It takes experience to choose the right one and engineer it into a drying system that will exactly meet your needs.

Kemp offers you that experience . . . almost a quarter-century in designing and building drying apparatus. Kemp engineers combine the right equipment and the right desiccant into a unit that brings you dependability, ease of maintenance, and simplicity of operation. For any use . . . guarding pneumatically operated instruments and

tools...drying process gasses and inerts for blanketing and purging... pressurizing anhydrous liquids...liquid drying or any of a host of other applications...a Kemp Oriad or Convection type dryer will give you high efficiency drying at low cost.



To improve performance and cut costs in your operation, have Kemp engineers recommend a system for your plant. Your Kemp Representative will give you detailed information, or write direct for Bulletin D-100. The C. M. Kemp Mfg. Co., 405 East Oliver St., Baltimore 2, Md.













### Now They're Gold-Plating Computers Too!

To celebrate a milestone in the growth of their commercial computor business, Bendix recently turned out a gold-plated unit—their 100th G-15 since 1952. Purchased by Dow Chemical Co., the medium-size computor will be the third to help spur development of the fiber Zefran. Another iron in the fire is G-15 process control of actual fiber production. — Computer Div., Bendix Aviation Corp., Los Angeles 45, Calif. 84A

#### Relief Valve

Miniature valve developed for aircraft and missiles.

For high pressure operations where space is at a premium, the Mini-Relief may prove to be a valuable processing asset.

Made in tube size 4 ( $\frac{1}{4}$  in.), the entire relief valve is about the same size as that of a  $\frac{1}{4}$ -in. union. Each valve is factory set to any prescribed pressure within the range of 1,000 to 4,100 psi. Once set, the valve is not adjustable. Operating temperature is -65 to 400F.

Rated flow at set pressure is ‡ gpm. Valve resets at 90% of set pressure. A line of Mini-Chek valves ranging in sizes from ‡ to 1 in. is also available.

—Republic Mfg. Co., 15655 Brookpark Rd., Cleveland 11, Ohio. 84B

#### Centrifugal Liquifier

High capacity unit for lowmelting solids.

Although designed primarily for melting foods such as butter or frozen cream, the Bryant Centrifugal Liquifier may soon find considerable use for liquifaction of other industrial lowmelting solids.

The solid charge feeds onto a steam-heated rotating disk, melts, and is thrown off by centrifugal force. A barrier arrangement holds unmelted feed on the disk.

Feed rates equivalent to about 1 ton/hr. of butter are standard.—Bryant Machinery Corp., 67 Van Reipen Ave., Jersey City 6, N. J. 84C

#### Water Purifier

New unit delivers ultrapure process water.

Completely automatic, the Penfield demineralization system continuously delivers process water of 18 to 20 megohms resistance.

The system consists of a carbon pre-filter and two monocolumn demineralizers plus automatic controls. The columns alternate in operation on a rinse-purify-regenerate cycle. Effluent conductivity is measured and recorded continuously.

Shipped ready for operation, the systems are available in sizes from 10 to 10,000 gph.—Penfield Mfg. Co., 19 High School Ave., Meriden, Conn.

84D



#### Pipe Squeezer

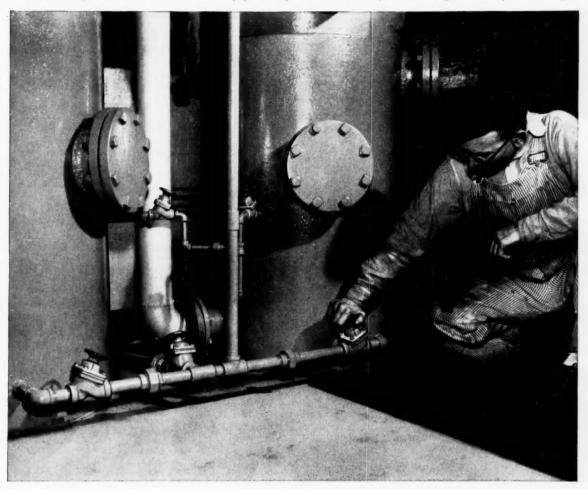
Versatile jack saves time, cuts costs.

Light, compact and easy to operate, a new hydraulic pipe squeezer saves many man-hours in certain pipeline installation and maintenance operations.

Typical applications include line-pinching to replace costly pressure-control fittings, repair of leaky lines, permanent closing of lines to buildings being demolished, and shutting off services to emergency areas when valves are inaccessible.

Designed for use on either cold or heated pipe, the squeezers handle steel pipe sizes up to  $2\frac{1}{2}$  in. O.D., copper pipe up to 3 in.—Regent Jack Mfg. Co., 11905 Regentview Ave., Downey, Calif. 84E

# How Liquid Carbonic stopped potassium permanganate leakage



# 700% longer service with these Crane valves...still going

This case history could save money in your own operation.

Liquid Carbonic Corporation, Seattle, Wash., is using these Crane packless diaphragm valves to handle potassium permanganate in lines to scrubbers. Before installing Crane No. 1610 ½" and 1" valves, this dry ice plant had to replace valves of another make at least every 6 months. Constantly recurring leakage around stems called for frequent stuffing box maintenance and hindered operations.

Since changing to Crane packless dia-

phragm valves, there has been no leakage, no trouble of any kind in  $3\frac{1}{2}$  years. Valve service is already 700% better. Here's why: Crane packless diaphragm valves completely eliminate the need for stem packing and the problems of stuffing box leakage and maintenance. The diaphragm seals the bonnet from line fluids.

Make sure your valves have correct design, better materials, precision assembly, thorough testing . . . insist on Crane, from the world's largest, most complete line of valves and fittings for industry.



ASK your Crane Representative for Crane Folder AD-1942 on packless diaphragm valves, or write Crane Co., address below.

# CRANE VALVES & FITTINGS

PIPE . PLUMBING . KITCHENS . HEATING . AIR CONDITIONING

Since 1855 — Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

CHEMICAL ENGINEERING—March 24, 1958



### Industrial Housemaid: Super Sweeper, Size 7 1/3 Ft.

Reported to be the world's largest vacuum sweeper, this machine devours all dust, dirt and debris in its 7-ft. 4-in.-wide path. A powerful vacuum system, coupled with a 540-sq. ft. filter, picks up and retains dust particles as small as 5 microns.

The main broom plus two gutter brooms sweep heavier materials into a 1½-cu. yd. hopper. The sweeper maneuvers easily around cars, machinery and buildings at a 15-mph. clip.—G. H. Tennant Co., 721 N. Lilac Dr., Minneapolis, Minn. 86A

#### Rubber Products

Line includes expansion joints and flexible pipe.

A new family of rubber expansion joints and flexible pipes, recently introduced by GRC, absorbs vibration, stops stresses caused by pipe expansion or contraction, and compensates for minor piping misalignments.

The rubber products have already proven themselves in pressure and vacuum service with acids, alkalis, organic solvents, slurries and gases.

Manufactured in sizes from ½ in. to 6 ft. I.D., both joints and pipes are available in three styles—for pressure, vacuum, or pressure and vacuum operation. Flexible pipe comes in lengths up to 50 ft.

Recommended maximum working temperature is 180 F.; maximum pressure and vacuum are 150 psig. and 30 in. Hg, respectively. Units for higher pressure and temperature are obtainable on request.—General Rubber Corp., Summit and Atwood St., Tenafly, N. J. 86B

#### BRIEFS

Nylon-enclosed mercury switch resists oils, alkalis and acids. Rated 3 amp. at 115 v. d.c., the switch offers dependable operation from -35 to 200 F. -Micro Switch, Freeport, Ill. 86C

Thermistor assemblies for gas chromatography applications offer matched voltages at four points to within 0.03 v.

—Fenwell Electronics, Inc.,
Mellan St., Framingham,
Mass. 86D

Air-powered drum pump delivers minute or volume quantities of drum-shipped liquids. Simple, one-man operation empties containers smoothly and continuously, with no internal pressure on the drum.—Gray Co., Inc., 1016 Sibley St. N. E., Minneapolis 13, Minn. 86E

Ball-valve manufacturer adds two new sizes to his line. Made from carbon or stainless steels, bronze or aluminum, Jamesbury valves are now available for 6-in. and 8-in. lines.—Jamesbury Corp., 45 New St., Worcester, Mass.

### **Equipment Cost Indexes**

	Sept.	Dec.
	1957	1957
Industry		
Avg. of all	225.0	229.2
Process Industries		
Cement mfg	216.6	220.7
Chemical	226.6	230.4
Clay products	210.4	214.4
Glass mfg	214.0	217.6
Paint mfg	217.4	221 6
Paper mfg	218.3	222.0
Petroleum ind	222.0	226.3
Rubber ind	224.8	229.1
Process ind. avg	223 7	227.0
Related Industries		
lec. power equip	229.8	232.9
Mining, milling	228 0	231.8
Refrigerating	254.0	258.9
iteam power	212.8	216.9

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124–6 for method of obtaining index numbers; Feb. 24, 1958, pp. 143–4 for annual averages since 1913.

#### For More Information . . .

about any item in this department, circle its code number on the

#### Reader Service

postcard (p. 187)

# From Slurry To 0.3% Moisture!

CARRIER SPIRAL ELEVATOR PROCESSES EXPLOSIVE PELLETS

**DEWATERS • DRIES • ELEVATES • IN ONE OPERATION** 

AIR DRY

City\_

Product Outlet

- Air Inlet

**MATERIAL** — Explosive Pellets

CAPACITY - 2100 Pounds Per Hour

HORSEPOWER - Five

HEIGHT — 18' Overall (Equivalent to 118' of Horizontal Conveyor)

FLOOR AREA - 36 Square Feet

FABRICATION - 304 Stainless Steel

RETENTION TIME - 15 Minutes

Perforated Plate

PELLETS AIR-DRIED TO 0.3% MOISTURE

> Blower: 8000 CFM Pressure: 5" Water Temperature: 165°F.



SLURRY DEWATERED FROM 10% SOLIDS TO 97% SOLIDS IN TWO TURMS

Slurry Inlet.

CARRIER
HATURAL-FREQUENCY
PROCESS EQUIPMENT

Carrier Conveyor Corporation 110 North Jackson Street Louisville 3, Kentucky

Please rush complete information about Carrier Natural-Frequency Processing Equipment.

State

CHEMICAL ENGINEERING-March 24, 1958

# Petroleum Feels the Pinch

... prices tumbling all down the line

... octanes flirting with the magic number

... imports cresting all-time levels

John B. Bacon Assistant Editor Softening petroleum prices in the early months affirm that after one notably rough year the domestic oil industry can look forward to another.

The beleagured industry will most likely continue to suffer a pinch from three sides: prices, product quality and imports. Questions uppermost in the minds of producers and refiners alike are how bad will the squeeze be and how long will it last.

Current events forbode a longer, harsher squeeze than many had expected.

There's been an outbreak of sporadic price cutting since the turn of the year which threatens to crack oil's whole price structure. A few samples of local markdowns: Heavy fuel oil prices slide 20¢/bbl. in Pacific Coast areas; No. 2 fuel prices dip 0.25¢/gal. in Chicago; heavy fuel oil is cut 15-28¢/bbl. along the Atlantic and Gulf Coasts; gasoline drops 1¢/gal. in Ohio.

Even crude oil postings are not inviolate, of late.

► High Stocks, Soft Market— Cheap imports are helping to the whole petroleum market fiercely competitive. Even without the present level of incoming material (totaling 1.5-1.7 million bbl./day of crude and products), oil companies would have a hard enough time disposing of record-high stocks in today's apathetic market. And now demand (already 9% below the like 1957 period) seems unlikely to live up to expectations.

Refiners, while keeping prices competitive in the face of rising costs, must, of course, progressively upgrade products to hang onto old markets and lure new ones. Moreover, a trend to lowercost crudes means added capacity for treating products and intermediate streams and for higherseverity processing.

► Imports Control—Most volatile issue right now is the Government's voluntary-imports program for crude oil. Recent events could topple the whole system.

A score or more potential new

importers are lining up for crude quotas totaling over 250,000 bbl./day. It's improbable that established importers are willingly going to reduce quotas enough to make room for them.

Many producers now rankle under record-low allowable schedules, yet some decline to sell crude at current postings. And Imports Administrator Carson, underscoring refiners' plight, points out that they are just as important to national defense as producers.

Solution of these difficulties may be mandatory controls or extension of voluntary imports quotas to products as well as crude oil.

▶ Rough Market Year—One big reason for a tempered market outlook is that the oil industry, with record-high stocks on hand, has already endured a critical period of slack demand, and it's now doubtful that hoped-for demand will materialize in future months.

Here's why:

• 1957 year-end stocks totaled more than 843 million bbl. of crude and products, an increase of 8% over 1956 year-end stocks. Crude production and runs to still are being curtailed in an effort to lower these stocks; but refiners, already operating at only about 85% capacity in early 1958, certainly won't cut levels below economic operating limits.

 Oil companies lost about 25 million bbl. of demand from mid-September to early February because of warm weather.

• To recoup these losses, oil firms must sell an amount of gasoline well above even the most optimistic forecasts. An increase in demand of about 6% for gasoline would balance the sales sheet. But realistic predictions call for only a 2-3% increase.

• Furthermore, natural gas and liquid petroleum gas (LPG) will continue to make steady inroads on fuel and heating-oil markets. Natural-gas demand will climb 6% from 1957, to a total of 11,369 billion cu. ft.



# Take the tedium out of correlation studies with this powerful electronic computer ROYAL PRECISION LGP-30

# Large capacity ... easily programmed and operated ... mobile ... low in cost

Compact, simple to use . . . Royal Precision LGP-30 brings high-speed electronic computation right to your desk . . . relieves you of the tedium of statistical analysis in such areas as research and product development, quality control and process control. And at the lowest cost ever for a complete computer system!

Faster answers; unusual capacity. Used wherever you want it, LGP-30 operates from any conventional wall outlet, is self-cooled. Providing fast, effortless answers for all types of statistical studies—correlations, analysis of variance, regression analysis, curve-fitting—LGP-30 gives you speed and memory (4096 words) comparable to computers many times its size and cost . . . stored-program operation for complete flexibility. Result: you save valuable time . . . handle more assignments . . . go forward to truly creative work.

Easy to operate and program. Controls have been so thoroughly simplified, LGP-30 may be operated with only minimum computer experience. Answers are printed out directly . . . do not require deciphering. Programming is easily learned. A library of sub-routines, plus programs for a wide variety of applications (including Box technique for experimental design), are available. Wide range; exceptional value. The most powerful computer of its size yet developed, LGP-30 is the greatest value in today's market. Remarkably small initial investment is combined with low operating and maintenance costs. Service facilities are available coast-to-coast. For further information and specifications, write Royal McBee Corporation, Data Processing Equipment Division, Port Chester, N. Y.

# ROYAL MCBEE

WORLD'S LARGEST MANUFACTURER OF TYPEWRITERS
AND MAKER OF DATA PROCESSING EQUIPMENT

# Newer Refining Processes Meet the Octane Challenge

		Charging Capac	ity
		Thousand Bbls./C	
		7/1/58	
Crude distillation	. 8,940	9,207	9,443
Thermal process (fresh fee	d)		
Reforming	278	216	209
Gas oil cracking*	610	622	600
Residuum cracking			
Coking			
	2,132	2,074	2,104
Catalytic cracking			
Fresh feed	2,993	3,089	3,283
Total feed	3,871	4,040	4,320
Catalytic reforming	.1,177	1,649	1,754
Hydrogen treating			
Cat reformer feed	585	1,009	1,122
Other feeds	41	90	472
Product treatment			
	923	1,503	1,074
		roduction Capac	city
Lubricating oil	(T	housand Bbls./D	ay)
Solvent extracted	120	122	122
Other types	78	77	77
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	198	199	199
Isobutane isomerization	15	25	27
Catalytic polymerization .	126	130	132
Alkylation			
Source: National Petroleum Committee;			

• Lastly, some economists take a skeptical view of forecasts for a business upswing at mid-year. They consider a possible upturn around the end of the year as more likely.

Whither Demand?—With such factors at work, even the moderate Bureau of Mines forecast may not be realistic enough. Bumines sees no change in total demand (including exports) for all oil products and a 2.5% increase for domestic demand.

Compared with 1956 and 1957 figures, the outlook for 1958 is slightly better for domestic demands (up 1.8% in 1957), but bleak as concerns total demand (up 3.2% in 1957). Caught in the unforeseen supply-demand squeeze, many oil companies, in their year-end financial statements, showed little or no gain over 1956 net profits. A scattered few fell markedly short of 1956 net figures.

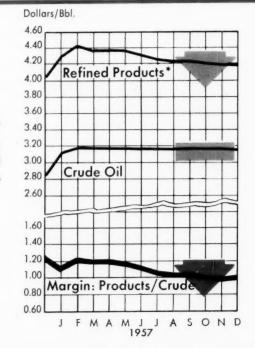
Moreover, since 1955, a peak year for oil, percentage increases in total demand have steadily narrowed—to what may be the vanishing point in 1958. Domestic oil firms, of course, don't expect such conditions to persist.

Octane Pinch: Wringing higher-grade products from lower-grade crudes calls for fancier refining techniques.

dergo residuum cracking.

Price Pinch: Caught between weakening product prices and firm crude prices, the refiner's margin slips away.

Source: National Petroleum News,
\*Gasoline, kerosene, light fuel, heavy fuel





### News trom

# National Carbon Company

Division of Union Carbide Corporation - 30 East 42nd Street, New York 17, N. Y.

Sales Offices: Atlanta, Chicago, Dallas, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco. In Canada: Union Carbide Canada Limited, Toronto

# National Carbon representatives expand your engineering force



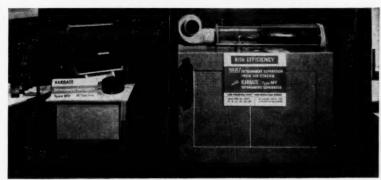
R. L. von HOHENLEITEN, SALES ENGINEER

Mr. von Hohenleiten has spent the past seven years representing National Carbon Company to the chemical processing and allied industries. He was graduated from Johns Hopkins University with a B.S. in chemical engineering and is a registered professional engineer in Texas.

His first few years with National Carbon Company were spent with an engineering group developing new designs and improving existing designs of "Karbate" chemical processing equipment. Von Hohenleiten was first active as a Sales Engineer on the west coast and is now serving customers in the southwestern section of the country.

Mr. von Hohenleiten is qualified to aid in the selection, special designing and installing of carbon, graphite and "Karbate" impervious graphite processing equipment. Call your National Carbon Sales Engineer today.

# "KARBATE" CORROSION RESISTANT ENTRAINMENT SEPARATORS PROVIDE HIGH OPERATING EFFICIENCY



Efficiency of entrainment separators demonstrated at the 26th Exposition of Chemical Industries.

Data collected from many installations prove "Karbate" Impervious Graphite Entrainment Separators — Type MV are an efficient and economical means for removing entrained liquids from gas streams.

For example, one such entrainment separator (installed in a line carrying toluene mist and vapor) helped recover approximately 36 gallons of toluene in five days of operation. With toluene

valued at 35¢ a gallon, this represents quite a saving. Although the recovery operation required additional process equipment, the entrainment separator will pay for itself in a short period of time.

These type MV entrainment separators operate through a combination of venturi action and impingement... contain no moving parts... and are non-clogging. Because liquid and gas contact only "Karbate" impervious graphite, units are virtually immune to corrosion over a temperature range from 40°F. to 338°F.

Standard sizes of "Karbate" entrainment separator — Type MV assemble directly into 6", 8", 12", 16", 20" and 24" horizontal lines. Units are self-contained and ready to install. For details, request Catalog Section S-6900.

# PACKAGED HCI BURNING, ABSORBING AND STRIPPING SYSTEM TO GO ON STREAM

A complete system to produce anhydrous hydrogen chloride starting with hydrogen and chlorine will go on stream soon at a high energy fuel plant. This integrated system includes the burning of hydrogen and chlorine in a graphite combustion chamber, absorbing the product hydrogen chloride in a "Karbate" falling-film absorption system, and finally stripping the concentrated hydrochloric acid from the absorber in a "Karbate" tower. The system was designed com-

plete with instrumentation and support structures by National Carbon

The system's steps are made up of packaged components using standardized "Karbate" impervious graphite and graphite equipment. "National" engineers will work up the complete system to your specifications. Literature is available on the "AG" system (for producing anhydrous HCl gas) and the "CA" system (for producing hydrochloric acid).

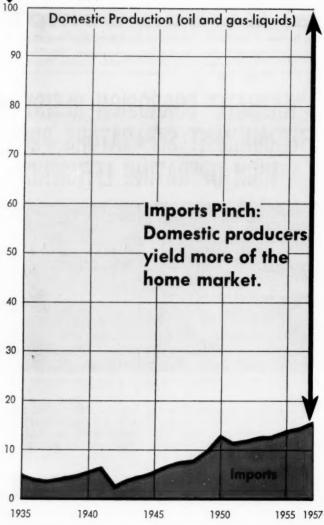
"KARBATE" ENTRAINMENT SEPARATOR - TYPE MY SEPARATION EFFICIENCY AT AVERAGE FLOW BATE			
Liquid Particle Size (Sp. Gr.=1.0) Micross	Percentage Removed from Steam at 4" Hg Absolute	Parcentage Remove from Air of 1 Atmosphere	
11.0	100	99.8	
7.8	100	93	
5.1	99.9	46	
4.0	98	11	
3.4	94	0	
1.7	0	0	

The terms "National", "Karbate", "Union Carbide" and "N" and Shield Device are registered trade-marks of Union Carbide Corporation.









# Petroleum Product Growth in '58:

# ... Stronger by a Shade

(Thousand barrels/day)

	154	232	9,143
All Other Products	46	69.	1,585
Residual Fuel Oil			
Middle Distillates			
Gasoline			
	1956	1957	Volume
Product	1957/	1958/	1958
	Increase in	Demand	

Source: American Petroleum Institute

But they know it means girding for an all-out fight to upgrade products and downgrade costs.

► Spending Will Be Up—A large part of oil's augmented capital expenditure in 1958 of \$6.038 billion will be directed toward this problem. From well-head to refinery gate, emphasis on fine products, low cost.

is on fine products, low cost.

Major share of capital expenditure, as in past years, will be tabbed for exploration, drilling and producing activities.

A sizable chunk, however—

A sizable chunk, however over 15%—is earmarked for new and improved processes to turn out better refined products.

► Hydrogen Treating Booms— Most dramatic processing event of the year promises to be the booming use of hydrogen processing to treat distillates, naphthas, cracked fractions, lube oils, gasoline and waxes.

Chief purpose of hydrogen processing, or hydrotreating, is to remove sulfur and other impurities and to saturate olefins and aromatics. Thus the increasing use of hydrotreating reflects trend to processing of high-sulfur or cheaper crudes.

Hydrotreating is already widely used for preparing cat cracker and cat reformer stocks. But by midyear, there'll be a 90% jump over a year ago in capacity for hydrotreating reformer feed alone.

► Cat Reforming Gains—In the same period, catalytic reforming capacity is slated for a rise of over 32% and cat cracking, nearly 37%. More gasoline of higher octane is the spur.

Coupled with rising capacity, moreover, is a definite trend toward higher-severity cracking and reforming. Cat cracker recycle rate (as percent of total feed), according to National Petroleum Committee figures, rose from 22.3% in 1956 to 23.7% in 1957, and will edge up to 24.5% this year. Higher recycle ratio gives more gasoline and light ends but at lower yield. ► Alkylation on Rise—Alkylation to produce high octane alkylate for motor fuel and avgas is another favored process that will see heavy use in the next years. Alkylation capacity will rise about 23% over last year. Much of this capacity will be in the form of new units.

# U.S.I. CHEMICAL NEWS

March

A Series for Chemists and Executives of the Solvents and Chemical Consuming Industrie

1059

### Polyethylene-Brass Bonds Possible with New Adhesive

A new adhesive developed by Bell Telephone Laboratories and reportedly able to resist a pull of 1,000 psi is being used to bond polyethylene directly to brass, brass-plated metals, and rubber. It is based on a compound described as partly hydrogenated polybutadiene, which is vulcanized by the addition of other materials. Any degree of unsaturation of the polybutadiene from 3-30% is reported to provide excellent adhesive action.

Temperatures from 250-350 F and pressures of 100 psi or less are required for bonding. A layer of the adhesive 2 or 3 mils thick is desirable. This layer can be brushed or sprayed on, or inserted between the materials to be bonded as a thin, prefabricated sheet.

Possible uses include bonding of polyethylene to brass in submarine cable amplifiers for underwater phone cables, linings for tanks and plating racks.



Sandwich of brass, polyethylene and rubber shown here is held together by new adhesive. It can support about 2,000 pounds.

### ISOSEBACIC® Acid Synthesis To Be Described At April ACS Meeting

A paper on U.S.I.'s new dibasic acid synthesis is to be presented at the symposium on alkali metals, being held at the 133rd national ACS meeting in San Francisco, April 13-18.

The process described in the paper was developed for use in the company's new ISOSEBACIC® Acid plant which is soon to go on stream. In this synthesis, butadiene is reacted with very finely dispersed sodium to form disodiooctadiene — an organometallic compound. Carbonation, hydrogenation and acidification then yield three major products — sebacic acid. 2-ethylsuberic acid and 2,5-diethyladipic acid. The mixture of the three has been trade named ISOSEBACIC Acid by U.S.I. and is finding application as a vinyl plasticizer and as an intermediate for many plastic applications. Until the

development of this synthesis, 2-ethylsuberic and 2,5-diethyl-

MORE

# National Petro-Chemicals Corp. Becomes a Wholly-Owned Subsidiary of National Distillers

Giant Tuscola, Illinois Plant Continues Under U.S.I. Management

Panhandle Eastern Pipe Line Company's 40% minority interest in National Petro-Chemicals Corporation has been transferred to National Distillers, which thus becomes sole owner. Panhandle has acquired 1,500,000 shares of National

### Attention: Users of Taxpaid Alcohol for Nonbeverage Purposes

The Alcohol and Tobacco Division of Internal Revenue has recently issued Industry Circular No. 57-37 covering the filing of non-beverage drawback claims on taxpaid alcohol by manufacturers of nonbeverage products. This circular suggests that such claims be delivered personally to the office of the assistant regional commissioner (alcohol and tobacco tax), or sent by registered or certified mail, with postmarked receipt.

The suggestion has been made in order that the time of filing claims may be more readily established. It appears that in the past some claims placed in the mail within the 3-month filing period have not been received in proper time. Without proof of the time of filing, the Division has been unable, under the law, to allow refund in such cases.

### New Technique for Bonding Non-FerrousMetalsEmploys Alkali Metal Chloride Mix

Non-ferrous metals which are difficult to join by welding, brazing or soldering can now be bonded by a new and inexpensive process. A solder-like wire, consisting of a mixture of zinc, lithium, potassium and sodium chlorides wrapped in a zinc sheath, is applied to the metal surfaces to be joined after they have been heated to 800°F, the melting point of the wire.

The bond formed is chemical — a eutectic mix of zinc, the alkali metals, and the metals being joined. It is claimed to be strong, corrosion-resistant, and with electrical, physical and chemical properties similar to the metals concerned. Similar or dissimilar surfaces can be bonded using the new technique.

Among the materials which, it is claimed, can be joined by this technique are titanium, zirconium, aluminum, copper, magnesium, zinc. brass, silver, gold, beryllium, platinum, osmium, thorium, uranium, vanadium, tungsten, and some types of steel.

Distillers common stock in exchange.

National Petro owns and operates a large integrated petro-chemicals plant at Tuscola. Illinois. U.S.I. Division of National Distillers will be responsible for management of this chemical complex as it has been in the past.

Expansion of National Petro beyond the original plan was one factor that led to the transaction. As originally conceived, Petro's basic raw materials were hydrocarbons extracted from Panhandle's natural gas pipeline at Tuscola. However, the company's new polyethylene plant at Houston will use ethylene purchased from another source.

#### Nixon Named Petro Vice President

John W. Nixon has been elected Vice President of National Petro, and manager of all National Distillers operations at Tuscola, including the Petro and U.S.I. facilities. Dr. Robert E. Hulse, National Distillers Executive Vice President, was named National Petro Executive Vice President, and Robert Cornwell, U.S.I. Vice President in Charge of Production, has also been named a Petro Vice President.

Since 1951, Petro has been producing ethylene, ethyl alcohol, ethyl chloride, ethyl ether, LPG and later polyethylene at Tuscola. It supplies hydrogen to U.S.I.'s ammonia production facilities. Petro also has the facilities to manufacture other related bulk chemicals on long term contract basis if the demand arises.



Panoramic view of a portion of the National Petro-Chemicals Corporation plant. Ethyl chloride, ethyl ether and ethyl alcohol production and storage facilities are visible in the background.

March

# **U.S.I. CHEMICAL NEWS**

1958

CONTINUED

ISOSEBACIC

adipic acids were relatively unknown.

Reaction conditions are very closely controlled to dimerize butadiene. If polymerization of butadiene were to occur, yields would be drastically reduced.

The paper describes prior art on the synthesis and general laboratory procedure, discusses the reaction and isomer distribution, and mentions other applications of the synthesis. It will be presented by Dr. Charles E. Frank, Manager of U.S.I. Organic Research.

Other Alkali Metals Symposium Topics

Some of the other topics planned for the alkali metals symposium are: New developments in liquid metals handling equipment; alkali metals as polymerization catalysts; sodium as a nuclear reactor coolant; manufacture of titanium by sodium reduction; alkali metals derivatives as components of Ziegler-type polymerization catalysts; manufacture of synthetic natural rubber, and large scale manufacture of sodium borohydride.

Paper on Titanium Patent Literature

A paper entitled "Survey of Patent Literature on Preparation of Titanium Metal" will be given for the Division of Chemical Literature at the San Francisco ACS meeting. This report, to be presented by Dr. Janet Berry who manages U.S.I.'s patent section, will graphically illustrate the great growth in titanium technology from patents obtained during the past 35 years.





Dr. Janet Berry and Dr. Charles Frank will present papers at the April ACS meeting in San Francisco.

Zirconium Provides Bright Light in Tiny Flashbulb

A new photoflash bulb is now on the market which is one-fourth the size of conventional bulbs, yet provides the same amount of light. In addition, the new photoflash gives faster light, and is therefore claimed to be the first bulb which can satisfy both box camera users and professionals who require speed.

These results have been accomplished by replacing shredded aluminum with shredded zirconium. The latter metal oxidizes more efficiently, giving 50% more light per unit weight of oxygen consumed. It creates lower pressure at flash peak, permitting higher initial pressure for faster light. It burns cleaner, blackens the bulb less, and so gives more light.

The new bulb costs no more than regular photoflashes, even though zirconium is cur-rently more expensive than aluminum. Increased production by zirconium suppliers like Mallory-Sharon Metals (owned 1/8 by U.S.I.) is expected to make zirconium available in larger quantities for this and other uses.

Methionine Overcomes Urinary Infections

Large doses of methionine have cleared up stubborn urinary tract infections which are resistant to antibiotics or other therapy, according to experiments at an eastern medical school.

Upon oral ingestion, methionine acted as an urinary acidifier, and reduced both the pH and the bacterial count of the urine. After methionine intake, the urine contained an antibacterial substance not present before methionine was given.

#### Have you a new product to tell the world about?

Make it routine to send your publicity releases to U.S.I. Chemical News, often called the "Front Page of the Chemical Process Industries." Write the Editor at the address below.

#### TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

Polyethylene containers can now be coated with a varnish said to cut static, give high sheen, prevent scuffing. Another coating now available is claimed to reduce oil permeability and oxy-gen diffusion, give glass-like clarity. No. 1331

Ceramic woven fabrics for high-temperature insulation have been introduced which will withstand heat up to 2,000°F., according to producer. Made of aluminum silicate fiber, they are lightweight, flexible, have low bulk factor.

No. 1332

New silicone compound containing salicyl groups in its structure can now be obtained. It is said to provide sunscreening action, does not wash off easily in water. No. 1333

Porous teflon filter cups 12 inches high by 5 inches I.D. can now be obtained for atomic energy use. These cylindrical cups are molded in one operation, are porous in the lower 7 inches only. They remove particles over 3 No. 1334

Acylase I, an enzyme obtained from hog kidneys and capable of separating many synthetic dl-amino acids, is now available in developmental quantities. Enzymatic resolution is said to be more economical than other techniques.

No. 1335

New type of stirring paddle combines centrifugal force, suction, shearing action, counter whirl. Claimed to promote high flow velocity through entire vessel, ensuring maximum dispersion with minimum particle size.

No. 1336

Acrylic emulsion paint behavior under test exposure in every climatic region in the U.S. is reported in a 56-page brochure just published. Detailed summaries, tables and photos on 3,000 tests which began in 1952-53 are included.

New infrared analyser has been announced for measuring concentrations of gases of medical interest such as carbon dioxide, nitrous oxide, cyclopropane, etc. It is expected to be used in such work as pulmonary investigations and research on new anesthetics.

No. 1338

A method for restoring the flavor of processed foods by adding flavor enzymes is described in a reprint now available. The studies described were carried out on cabbage and related foods, but the method works with many other foods. No. 1339

#### PRODUCTS OF U.S.I.

#### **ALCOHOLS**

Ethyl Alcohol (Ethanol): Specially denatured — all regular and anhydrous formulas. Completely denatured — All regular formulas for industrial use, anti-freeze. Pure alcohol — USP 190° — Absolute, N.F., taxfree, taxpaid.

Proprietary Denatured Alcohol Solvents: SOLOX® — General-purpose. FILMEX® — Special, authorized for certain industries, ANSOL® M — Anhydrous, special blend for lacquers, resins, etc. ANSOL® PR—Anhydrous, special blend with higher ester content and solvency for lacquers,

#### OTHER PRODUCTS

PETROTHENE® Polyethylene Resins
Organic Solvents and Intermediates: Normal Butyl Alcohol, Amyl Alcohol,
Fusel Oil, Ethyl Acetale, Normal Butyl Acetale, Diethyl Carbonate,
DIATOL®, Diethyl Oxolate, Ethyl Ether, Acetane, Acetacetanichie,
Acetacet-Ortho-Chloranilide, Acetacet-Ortho-Toluidide, Ethyl Acetacetate, Ethyl Benzoylacetate, Ethyl Chloroformate, Ethylene, Ethyl
Sodium Oxalacetate, Sodium Ethylate, 1005EBACIC® Acid, Sebacic
Acid, Urethan U.S.P. (Ethyl Carbamate), Riboflavin U.S.P.

Pharmaceutical Products: DL-Methionine, N-Acetyl-DL-Methionine, Urethan USP, Riboflavin USP, Intermediates.

Heavy Chemicals: Anhydrous Ammonia, Ammonium Nitrate, Nitric Acid, Nitrogen Fertilizer Solutions, Phosphatic Fertilizer Solution, Sulfuric Acid, Caustic Soda, Chlorine, Metallic Sodium, Sodium Peroxide, Sodium Sulfite, Sodium Sulfate.

Reactive Metals, Oxides and Salts: Zirconium, Zirconium Oxide, Zirco-nium Tetrachloride, Titanium, Hafnium, Hafnium Oxide, Hafnium Tetrachloride.

Development Chemicals: Ethylaluminum Sesquichlaride, Methylaluminum Sesquichlaride, Manamethyl Hydrazine, Triethyl Aluminum, Trimethyl Aluminum, Unsymmetrical Dimethyl Hydrazine.

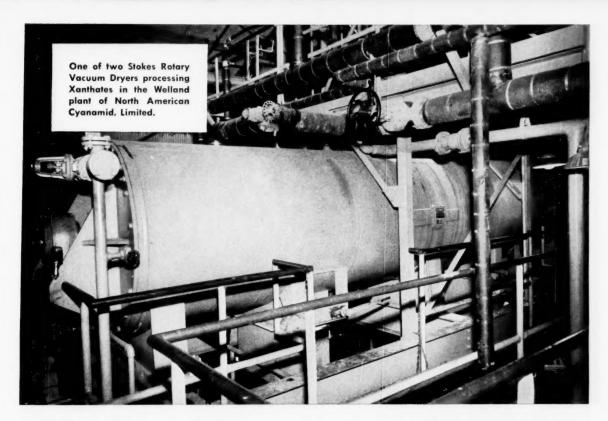
Animal Feed Products: Antibiotic Feed Supplements, BHT Products (Anti-oxidant), Calcium Pantothenate, Choline Chloride, CURBAY 8-G-9, Special Liquid CURBAY, VACATONE®, Menadiane (Vitamin Ks.), Methionine, MOREA® Premix, Niacin USP, Riboflavin Products, Special Mixes, U.S.I. Permodry, Vitamin Bız Feed Supplements, Vitamin D<sub>3</sub>, Vita-min E Products, Vitamin E and BHT Products.

# NDUSTRIAL CHEMICALS CO.

Division of National Distillers and Chemical Corporation 99 Park Avenue, New York 16, N. Y.

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# Stokes Rotary Vacuum Dryers process Xanthates for North American Cyanamid, Ltd.

North American Cyanamid's Welland plant, near Niagara Falls, Ont., is the only Canadian producer of Xanthates...a series of materials used in mining and mineral industries as flotation reagents. Stokes Rotary Vacuum Dryers play an important part in the production of these heat and air sensitive materials.

The standard "extra" features of these dryers give continuous operation that means no maintenance shutdowns—process uniformity that means more pounds of saleable products—and operating efficiency that means more profit.

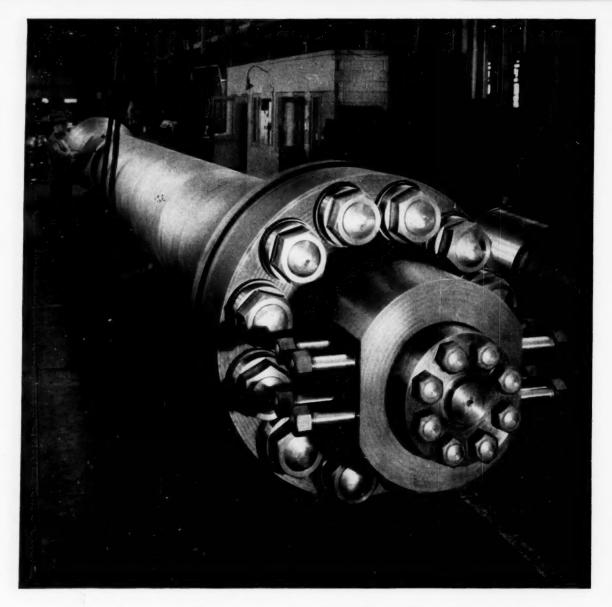
- Continuous double-spiral agitators...fast, uniform drying...easy unloading...low power requirements.
- Heated agitator shaft and arms . . . up to 25% greater heat transfer.

- Self-aligning, tapered roller bearings . . . low power requirements . . . less stuffing box wear.
- Plug-type, flush discharge door...no undried pockets...rapid unloading.
- Process-proved options, selected according to your product requirements...spring loaded scrapers ... heated or unheated, conventional or inverted dust filters...special construction materials... fixed or variable speed drums.

Stokes produces rotary vacuum dryers, rotating vacuum dryers, vacuum shelf dryers, drum dryers and flakers, tabletting equipment... maintains a complete laboratory to provide expert application assistance. Write Stokes, or contact your nearest Stokes office for complete information.

Vacuum Equipment Division
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia 20, Pa.





# **Big Ammonia Converter Ready for Duty**

Here's a strapping big pressure vessel undergoing its final checkup just before shipment. A forged ammonia converter, the vessel is a real heavyweight, the kind Bethlehem is often called upon to build.

It weighs more than 82 tons and is about 55 ft long. It has an ID of 29 in. and a body OD of 42 in. Under hydrostatic test it was subjected to pressures reaching 14,000 psi.

Bethlehem is equipped to build vessels both larger and smaller than this one. Moreover, they can be furnished in a wide range of types to meet the needs of the chemical, rubber, petroleum, and food-processing industries.

So, we suggest you get in touch with us whenever your program includes new vessels. Our engineers will gladly help in the planning of forged autoclaves, reactors, converters, separators, filters, or high-pressure accumulators.

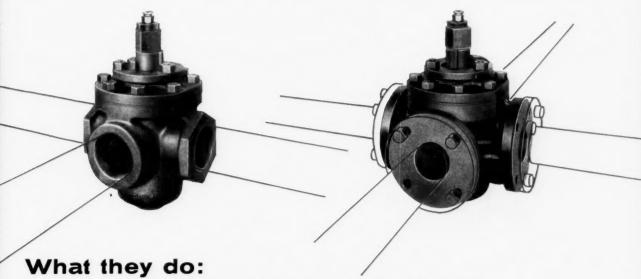
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation



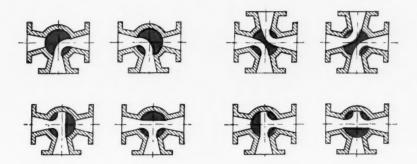
# BETHLEHEM STEEL

# WHERE WOULD YOU USE THESE VALVES?



One Rockwell-Nordstrom Multiport valve can do the job of three or four ordinary valves! By simply moving the lubricated plug through 90°, flow through the valve "ports" is stopped, or diverted. This means that piping is greatly simplified and the saving in valves is obvious. Rockwell-Nordstrom Multiport valves cost less to use, too, because the lubricant that assures positive shut-off also eliminates metal-to-metal wearing friction.

For just a few of the literally hundreds of stop and port arrangements, see the drawing below. How could you use these valves in *your* flow control system?



# Here are a few uses:

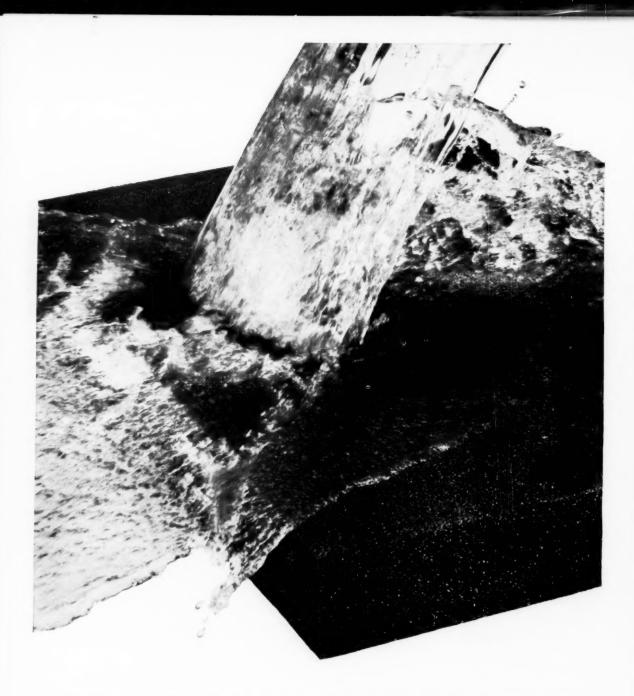
Rockwell-Nordstrom Multiport valves are used in the process industries for batching, blending and product flow control . . . they're used in refineries for product lines and pressure relief on vessels . . . they're used in many industries where flow must be stopped, changed or relieved. To get more information on where and how Rockwell-Nordstrom Multiport valves will save you money, send the coupon below.

ROCKWELL-Nordstrom VALVES

THE ROCKWELL

MANUFACTURING COMPANY

Rockwell Manufacturing Co. Pittsburgh 8, Pennsylvania		
<ul> <li>□ Please send bulletin V-203</li> <li>□ Please have your sales engineer call</li> </ul>		
Name	Title	
Address		
City	Zone	State



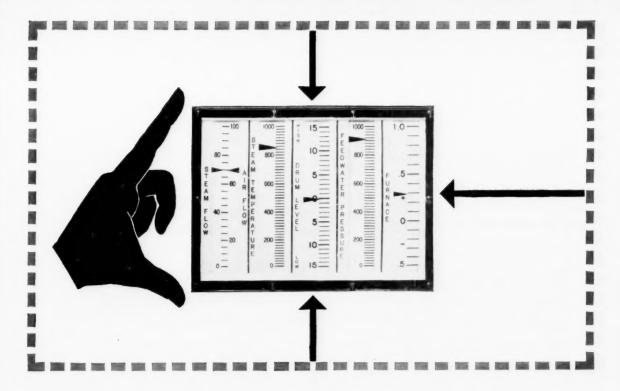
... always an insulation investment; never an insulating expense

# FOAMGLAS® IS MOISTURE-PROOF

Insulation that absorbs moisture soon stops insulating. That happens to most insulations, in time. It never happens to FOAMGLAS ... because FOAMGLAS is moisture-proof. Its sealed glass cells can never absorb water or vapor. It always maintains its full, original insulating value. There's more to this insulation investment story. FOAMGLAS is incombustible . . . dimensionally stable . . . unusually strong . . . acid-proof . . . vermin-proof . . . easy, economical to handle and install. Find out how to make this long-term investment in your own insulated buildings and equipment. Write for our latest catalog.

# PITTSBURGH CORNING CORPORATION

Dept. H-38, One Gateway Center, Pittsburgh 22, Pa. • In Canada: 57 Bloor Street West, Toronto, Ontario



Get big-gauge accuracy and sensitivity with

# Republic's V5 Series of Compact Measuring Instruments



Two sets of Republic V5 gauges mounted on a modern console-type boiler control panel. Gauges match the compactness of the other instruments, yet are easy to read—even from a distance.

Republic V5 gauges feature fullsized diaphragms, bellows and helixes, yet require only one-fourth as much panel space as ordinary instruments. Eight V5 gauges can be mounted in a single bank requiring only about 14" x 6½". This compactness makes them ideal for console or graphic type panels. Each V5 gauge is an independent unit, which may be removed or replaced without disturbing adjacent gauges. Each 5" vertical scale is illuminated from the rear for top readability even from a distance.

A full line of V5 gauges is available for measuring draft, pressure,

differential gas pressure and temperature, and for use as receivers with pneumatic transmitters for indicating flow, liquid level, density, high pressures and other process variables. If you would like to save panel space-without sacrificing instrument readability, performance and flexibility-a talk with your Republic engineer could be time well-invested. A card or a call will bring him. Republic sales offices are located in principal cities throughout the United States and Canada. Detailed information in Bulletin No. 806 . . . your copy is waiting.

#### A FEW OF THE OPTIONS AVAILABLE:

- Duplex bellows or helix gauges with two pointers operating on the same scale; occupies same space in group as a single-gauge unit.
- Set point indicator available on single bellows and helix units.
- Compound and reversed scales avail-
- Reverse acting pointer motion available. (Can be reversed in the field without any change in parts.)
- High and low alarm contacts can be provided with all types of units.

# REPUBLIC FLOW METERS CO.

Subsidiary of ROCKWELL MANUFACTURING COMPANY
2240 DIVERSEY PARKWAY CHICAGO 47, ILLINOIS
In Canada: Republic Flow Meters Canada, Ltd.—Toronto
Manufacturers of electronic and pneumatic
instrument and control systems for villity,
process and industrial applications.

# Silicone Insulated Motors Help Keep Production Moving

When the heat's on production and machines are pushed to rated capacity and beyond, motors get hot too. That's when it pays to have drive motors and essential auxiliary motors insulated with heat stable Dow Corning silicone insulation.

Silicone insulation withstands temporary overloads that burn out other insulation. Insulated with silicones, motors keep going even when pushed 50% above rated capacity, practically eliminating the most frequent cause of work stoppages.

If your plant is automated or has continuous processing lines you can rely on motors insulated with Dow Corning Silicones to keep production moving ahead.

What's more, you can count on reliable motor performance despite high ambients, moisture, plugging, rapid reversing or corrosive atmospheres.

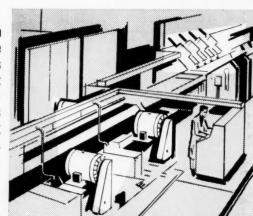
Leading motor builders now offer motors insulated with Dow Corning Silicones. Both ac and dc motors, silicone-insulated for longer insulation life, are available in standard frame sizes.

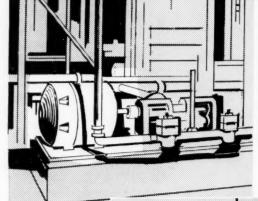
For maximum reliability and to keep production moving despite the heat of temporary overloads—

Specify DOW CORNING SILICONES

Write Dept. 263a for list of builders who offer Dow Corning silicone-insulated motors.

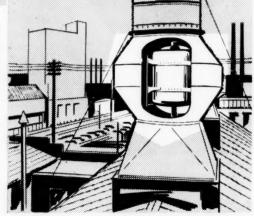
On production set-ups, where downtime is measured in lost profits, siliconeinsulated motors keep going despite overloads.





In continuous processing, fluid handling equipment stays "on stream" despite moisture, overloads and high ambient temperatures.

Silicones add reliability to essential auxiliary drive motors. This cupola exhaust fan motor is cooled by oven-hot air.



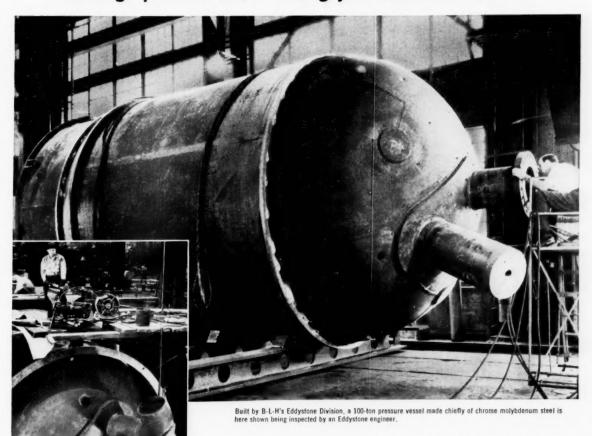


Dow Corning

MIDLAND, MICHIGAN

ATLANTA . BOSTON . CHICAGO . CLEVELAND . DALLAS DETROIT . LOS ANGELES . NEW YORK . WASHINGTON, D. C.

# 20 ft. long, 12 ft. in diameter, 13 kinds of steel . . . typical of the tough pressure vessel welding jobs Baldwin is noted for



Automatic submerged metal arc was one of three welding methods employed on this huge pressure vessel.



Identical vessels fabricated by B-L-H and installed in the catalytic reforming unit of an ultramodern refinery.

A major oil company recently called on Baldwin-Lima-Hamilton's Eddystone Division to weld two identical 100-ton pressure vessels that must operate continuously for long periods of time at nearly 1000°F in a hydrogenrich atmosphere at pressures up to 536 psi. Baldwin successfully met the challenge of this big job.

Thirteen different kinds of steel 3% in. to 51% in. thick and three welding methods—manual-shielded metal arc, automatic submerged metal arc, and inert gas—had to be used on the vessels, each 20 ft. long, 12 ft. in diameter. As on all Baldwin work, only qualified welders were used.

Radiographic inspection of all welds revealed no defects. After the vessels were hydrostatically tested at 1575 psi for 3 hours, all seams were examined for leaks and found to be tight.

For a copy of our illustrated Weldment Bulletin 7001 or for specific information on how we may be of service to you, write to B-L-H Corporation, Philadelphia 42, Pa.

# BALDWIN · LIMA · HAMILTON

Eddystone Division

Philadelphia 42, Pa.

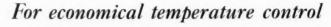
Hydraulic turbines • Weldments • Dump cars • Nonferrous castings • Special machinery • Bending rolls • Machine tools





Pyr-O-Vane Millivoltmeter Controller

Available in 150 standard ranges, and a variety of control actions. Both vertical and horizontal models can be flush or surface mounted.

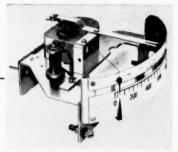


# A <u>COMPLETE</u> <u>LINE</u> OF BROWN MILLIVOLTMETERS

Careful attention to design and construction details makes Brown Millivoltmeters accurate—and rugged enough to stay accurate in hard use. They give reliable, low-cost temperature control for any heat-using process that doesn't require a chart record.

True plug-in design makes maintenance easy. You can change galvanometers and control units in *less than a minute*.

Choose Brown Millivoltmeters from 150 standard ranges and scales... for any safety or control application. And you can have a choice of either horizontal or vertical cases.

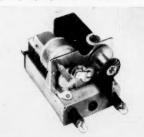


#### Plug-in galvanometer unit

High-strength Alnico magnet makes possible larger gap between magnet and core, reducing clogging due to dirt and dust. Triple ambient temperature compensation provided.

#### Plug-in pulse Pyr-O-Vane control unit

Control units available with choice of 10 different control forms. Proportional band adjustable between 1 and 3%; cycle timing change gears available for 3, 7.5, 12, 18, 30 or 72 seconds.



With Honeywell's complete line, there's no need to shop around for your various millivoltmeter accessories . . . from thermocouples and *Radiamatic* detectors to motorized valves and dampers.

Your nearby Honeywell field engineer will be glad to discuss your specific needs. Call him today . . . he's as near as your phone.

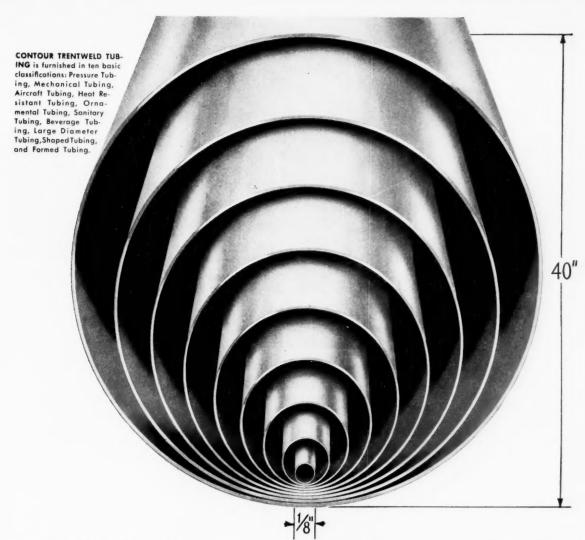
MINNEAPOLIS-HONEYWELL REGULATOR Co., Industrial Products Group, Brown Instruments, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Honeywell



First in Controls

March 24, 1958—CHEMICAL ENGINEERING



# TRENTWELD tubing is equal in strength and has more uniformity than tubing made by any other method of manufacture

Trent offers tubing in sizes ranging from 1/8" to 40" O.D. and in a wide range of grades. These include: Hastelloy,\* Zirconium, Zircaloy, Titanium and 19-9-DL grades. All are made by an exclusive welding process—Contour Trentweld®—which virtually eliminates the bead. Furthermore, by cold working and annealing after welding, Trent makes the weld equal in strength and corrosion resistance to the parent metal.

To insure that Trentweld tubing

is of the highest quality attainable, a rigorous quality control program is carried out. Samples of each lot are tensile tested. Periodic tests — flattening, reverse bend, flare and flange, coil, and pressure — are conducted. Rigid corrosion tests are made on all lots intended for corrosive applications. When requested, a unique "single-wall" X-ray inspection is made as your final assurance of a sound, uniform product.

Why not take advantage of Trent

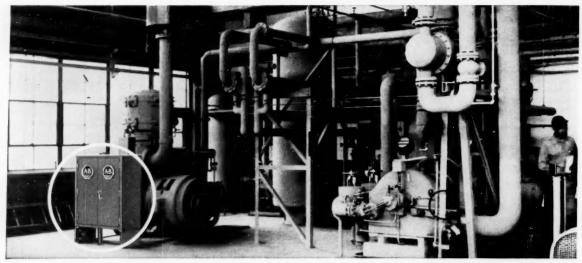
quality when you order stainless or high alloy tubing? For further information, write for the Trent tubing handbook, Trent Tube Company, East Troy, Wisconsin.

\*Trademark of Haynes, Stellite Co.



TRENT TUBE COMPANY

Subsidiary of Crucible Steel Company of America GENERAL OFFICES: EAST TROY, WISCONSIN MILLS: EAST TROY, WIS.; FULLERTON, CALIF,



# REDUCED VOLTAGE STARTERS easy on the motor . . . easy on the line

A-B Bulletin 746 automatic autotransformer starter for compressor supplying dry air in bulk plastics plant.

Only the Allen-Bradley line of reduced voltage starters can completely satisfy your motor and machine starting needs...whatever these may be. Starting "jolts" that can shorten the life of the equipment, or also cause damage to "parts" being produced, can be eliminated. The high current inrush, often resulting in objectionable lamp flicker, can be brought within the power company's requirements.

For the ultimate in reduced voltage starting, the compression resistor starters—produced only by Allen-Bradley—are unequaled for velvet smooth motor and machine acceleration. Allen-Bradley transformer-type starters are also "tops" in their field. All starters have double break, silver alloy contacts that never need maintenance.

Please call your A-B control engineer—he will help you select the correct starter for your needs. You cannot go wrong when you specify Allen-Bradley... the quality motor control.

Allen-Bradley Co., 1337 S. First St., Milwaukee 4, Wis. In Canada: Allen-Bradley Canada Ltd., Galt, Ont.



AUTOMATIC STEPLESS RESISTANCE

Bulletin 740 has graphite disc resistors automatically inserted in line for smooth starting. Ratings to 200 hp, 220-440-550 v.



#### AUTOMATIC AUTOTRANSFORMER

Bulletin 746 uses autotransformer in open delta to reduce line voltage. Taps on transformer to adjust voltage. Ratings to 300 hp, 220 v; 600 hp, 440-550 v.



MANUAL AUTOTRANSFORMER

Bulletin 646 has air break, silver alloy contacts. Rated 75 hp, 220 v; 150 hp, 440-550 v. Also made with oil-immersed contacts. Bulletin 646 is a strictly "modern" starter.



#### MANUAL STEPLESS RESISTANCE

Bulletin 640 has graphite compression disc resistors for stepless starting. Operated by a hand lever. Ratings to 200 hp, 220-440-550 v.



# PART WINDING

Bulletin 736 for use with suitable squirrel cage motors having separate parallel stater windings. Ratings to 200 hp, 220-440-550 v.





MOTOR CONTROL

# Solve Difficult Liquid Processing Problems

with the New



# TURBA-FILM° PROCESSOR

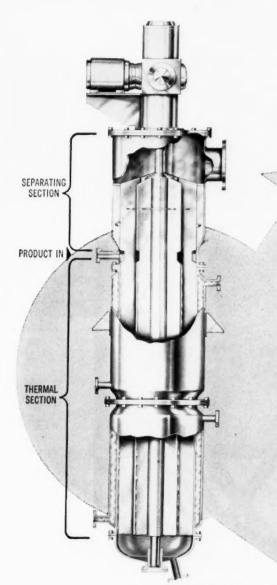
When viscous fluid processing is "bugged" by complex procedures, time-at-temperature-sensitive materials, sluggish control of product quality... look to the new Rodney Hunt Turba-Film Mark II Processor to simplify your problems.

Utilizing a turbulent thin-film technique, the patented Turba-Film Mark II Processor provides mechanically aided heat and mass transfer in one pass, continuously and rapidly, for a wide range of viscous fluids and slurries. It delivers controlled uniformity of product in

concentration . . . deodorization . . . dehydration . . . evaporation . . . heat transfer . . . reaction . . . stripping . . . and other processes.

Short-time exposure and minimum hold-up of the process fluid in the thermal section assures uniform heat and mass transfer, even at high temperature. Foaming is controlled by a mechanical separator and the formation of crust is minimized permitting continuous operation for long periods.

A large number of installations have proved conclusively the superiority of the Turba-Film Processor for processing chemicals, pharmaceuticals, lactices, solvents, foods and many other products.



PRODUCT OUT

# An Invitation

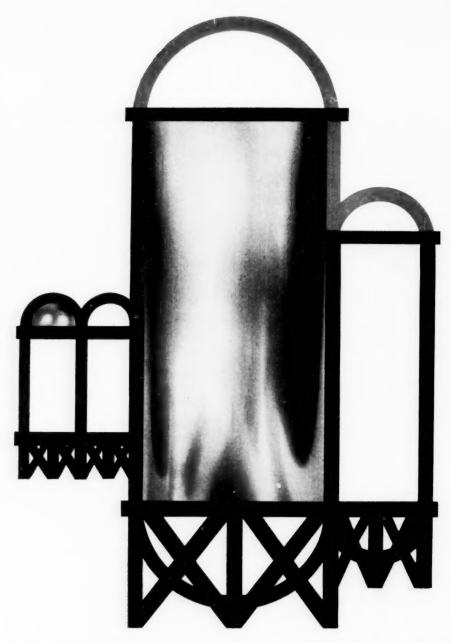
Rodney Hunt will be happy to work with you in solving your process problems, utilizing its extensive engineering, laboratory and pilot plant facilities. Address your inquiry to the Rodney Hunt Process Equipment Division or write for Catalog 117, the story of the Turba-Film Processor.



RODNEY HUNT MACHINE CO. PROCESS EQUIPMENT DIVISION

132 VALE STREET, ORANGE, MASSACHUSETTS, U. S. A.

SERVING THE PROCESS INDUSTRIES WITH EQUIPMENT AND ENGINEERING



# win the fight against corrosion—with Alcoa Aluminum

Chances are the staggering cost of corrosion is your most serious headache. If so, don't overlook this important possibility: there is probably a known—and proved—economical aluminum answer to your most serious corrosion problem. Alcoa engineers can show it to you.

Alcoa's corrosion specialists have accumulated over 1000 man-years' experience applying aluminum to solve corrosion problems in the process industries. Their un-

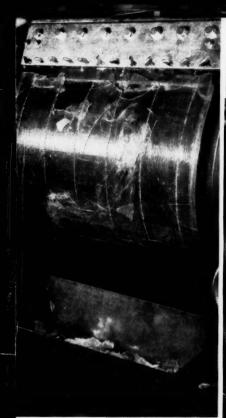
equaled experience has produced an immense fund of factual data on the behavior of aluminum with corrosive materials and in corrosive atmospheres. That data is at your service.

Let Alcoa's engineers show you how to win the fight against corrosion—with Alcoa® Aluminum. Outline your corrosion problems in a letter to Aluminum Company of America, 903-C Alcoa Building, Pittsburgh 19, Pa.

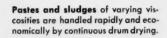


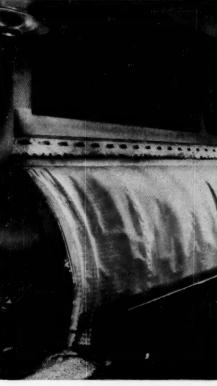


Specify Alcoa Aluminum for corrosion-free Process Equipment Pipe & Tube Tanks, Containers, Trucks & Cars Plant Structures



Molten materials, often repelled by smooth drum surfaces, are successfully handled on grooved drums.







Heavy or dilute liquids respond well when dried on equipment specifically designed for the process.

# How Buflovak Drum Dryers are tailored to improve your product... boost your profits

Whether you need a single drum dryer to handle simple solutions at low cost . . . an enclosed drum dryer to process toxic materials . . . a double drum vacuum dryer to protect heat-sensitive liquids, Buflovak builds the dryer to best meet your needs.

Five different types of drum dryers are just part of a complete line that includes atmospheric and vacuum types, with chamber, pan, rotary, spray and other models.

Backed by this complete line, Buflovak experienced engineers can *impartially* recommend the unit that meets known specifications...fulfills the requirements of individual product testing.

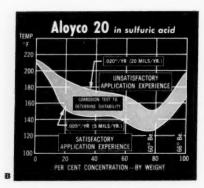
Select your dryer scientifically at the Buflovak Customer Service Laboratory An extensive line of small scale and pilot-size equipment is at your service for investigating drying, evaporation, extraction, impregnation and crystallization problems. Here you obtain accurate data and actual samples of your processed product, examine operation efficiency... thoroughly explore by-product possibilities.

Catalog 380 describes the Buflovak Dryer line; Catalog 381 fully describes Buflovak's lab. Both are available at your request. Additional facts also available in C. E. Catalog, pages 429 to 452.



#### **BLAW-KNOX COMPANY**

Buflovak Equipment Division 1551 Fillmore Avenue, Buffalo 11, New York



A. Your Problem in handling corrosives is discussed with a specialist when you sit down with an Aloyco Sales Engineer. He handles only one line, knows his business.

**B. Right Alloy** for your application is based on 29 years of specialized experience in the field plus continuing research in Aloyco metallurgical labs.

C. Valve Casting is made from Aloyco design in Aloyco foundry, only foundry ever built to produce pressure-tight Stainless Steel Valve castings, exclusively.

D. Special Techniques in machining stainless steel, plus most modern equipment in Aloyco plant assure you precise tolerances, trouble-free performance.

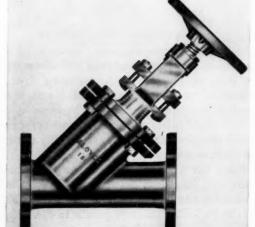
E. Aloyco Y Valve, shown here in various stages of production, is one of Aloyco's complete line of valve types, alloys, sizes, pressures—including nuclear valves.







## BEHIND EVERY ALOYCO VALVE... specialization



... to help you handle corrosives

Valves often look alike—even stainless steel valves. But they won't necessarily perform alike when you get them into the line.

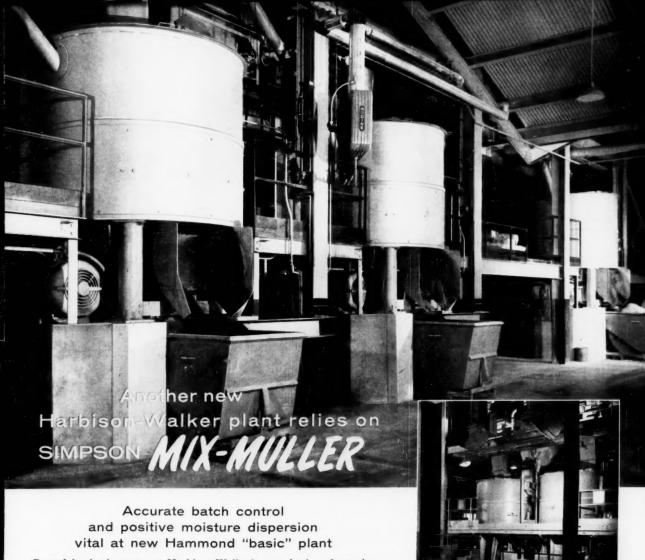
Here are some of the special skills and facilities that make the difference between Aloyco valves and others. Some of the "extras" you get with Aloyco valves are staying power, minimum maintenance, trouble-free operation in severe as well as mild corrosive service. Doesn't it make sense that the one company specializing in the manufacture of Stainless Steel Valves exclusively is your

best source of supply?



ALLOY STEEL PRODUCTS COMPANY

1308 West Elizabeth Avenue, Linden, New Jersey



Control is the keynote at Harbison-Walker's new basic refractories plant recently completed at Hammond, Indiana. Seven stories of the most up-to-date screening, batching and proportioning equipment help deliver precisely controlled, accurately proportioned materials to the mixing floor. Here, three 2½F Simpson Mix-Mullers provide intensive controlled dispersion of moisture, binders and basic materials, to predetermined properties—for delivery to a battery of power presses.

At Hammond, as at many modern Harbison-Walker plants—and in the refractory operations of leading producers *all over* the country, Mix-Mullers are relied upon for the positive moisture control, intensive blending and controlled dispersion that is so necessary to the scientific production of dense, precision sized, precision *performing* refractory products.

Wherever quality and control really count—in the preparation of any dry or wetted solid . . . you'll find Simpson Mix-Muller in the key slot.

WRITE FOR BULLETIN showing how Mix-Muller is used throughout the Chemical & Process Industries.



SIMPSON MIX-MULLER DIVISION

National Engineering Company
636 Machinery Hall • Chicago 6, Illinois

Above: Two of six No. 3 Mix-Mullers used to prepare all silica refractory material at Harbison-Walker's Windham, Ohio plant. In all, Harbison-Walker uses more than twenty Simpson Mix-Mullers.

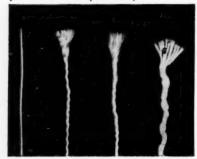
Belaw: View from mixer platform showing 21/2 F Mix-Mullers at Harbison-Walker's Hammond, Indiana plant. Weigh larry in background is charged from overhead bins. Is used to receive components for precisely proportioned 4000-lb. batch



P-258

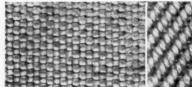
# Test your FILTER FABRIC KNOWLEDGE here!

1. Yarns are the basis of fabric construction. Yarns shown here are plied, spun single, monofilament, multifilament. Can you match them up correctly?

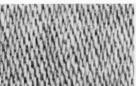


Processing engineers have to know many things, but they don't necessarily have to be filter fabric experts. Not when they can rely on Wellington Sears and the specialists who distribute our filter fabrics. This little test will help you check your knowledge of some basic fabric facts. It will also serve to remind you of the help always available through Wellington Sears. For more information write for "Filter Fabric Facts," Dept. L-3, Wellington Sears Co., 65 Worth St., New York 13.

2. Weaves are just one factor affecting filter fabric performance. Here are three basic weaves, satin, twill, and plain, plus one variation, chain cloth. Can you identify all of them?









3. These are cross-sections of Orlon\*, cotton, dynel, and nylon fibers. Which are which?









Turn upside down for answers

2. a. plain, b. twill, c. satin, d. chain 3. a. nylon, b. Orlon, c. dynel, d. cotton

1. a. monofilament, b. multifilament, c. spun single, d. plied

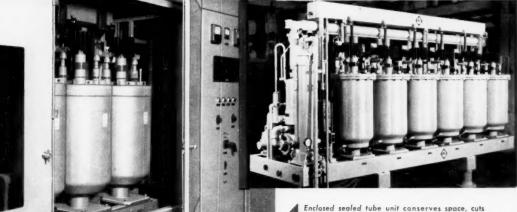


DuPont's trade mark for its Acrylic fiber.

WELLINGTON SEARS

FIRST In Fabrics For Industry • Wellington Sears Company, 65 Worth St., N.Y. 13, N.Y. Offices in: Atlanta • Boston • Chicago • Dallas • Detroit • Los Angeles • Philadelphia • San Francisco • St. Louis

Open pumped tube unit permits easy access for inspection. Easy to recondition in field.



Enclosed sealed tube unit conserves space, cuts installation costs, eliminates need for vacuum pumping system.

ALLIS-CHALMERS

Mercury Arc Rectifiers

## Pumped or Sealed? Open or Enclosed?

Here's how Allis-Chalmers can help you choose a rectifier for your job—

BOTH sealed and pump-evacuated tube rectifiers offer distinct advantages, depending upon the application. Whether your rectifier should be open or enclosed construction also depends on the application. Since Allis-Chalmers offers you a choice of sealed or pumped

tubes in either open or enclosed construction, you get an unbiased recommendation, based on a study of your needs, and not on commercial expediency. And you can be sure of unsurpassed reliability and ease of operation, as proved in hundreds of Allis-Chalmers installations.

### Only Allis-Chalmers Excitron Rectifiers give you all these important advantages—

- Fixed excitation anode does not contact mercury — is independent of level, turbulence or impurities.
- Continuous excitation eliminates need for reignition — pilot arc always present.
- Grid phase control located in clean region near anode where ion density is lowest.
- Internal cooling system provides high heat transfer with seamless tube coil.
- Arc-over-free tube eliminates arc-over danger by insulating entire arc path.
- Enameled anode seals provide high strength, trouble-free seal.

For detailed information on mercury arc rectifiers contact your nearest A-C office, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin, for bulletin 12B8494.

**ALLIS-CHALMERS** 



A-5560



New rotary kiln

New settler

Converted reactor

. . . highlight Kaiser Chemical's \$3million magnesia-plant revamp that

boosted output 50% to meet booming demand for high-purity refractory.



### Magnesia From Sea Via Streamlined Process

TEAMING astute engineering with seized market opportunity, Kaiser Chemical Div. of Kaiser Aluminum & Chemical Corp. has now come up with a \$3-million capacity expansion at its Moss Landing, Calif., magnesia-from-sea-water plant.

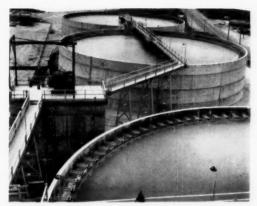
Spur behind the move: Industry's growing need for high-purity basic refractories as it turns with ever-increasing frequency to everincreasing operating temperatures now needed.

Result: Plant now processes 30 million gal./day of sea water—twice as much as it had previously—and turns out some 375 tons/day of magnesia; a production boost of over 50%.

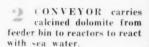
Moreover, putting slide rules and 14 years of experience in the seawater-magnesia business to work, Kaiser did more than just up output at Moss Landing. It incorporated a number of attractive engineering features right down the flowsheet line that count for improved process efficiency and higher product purity.

Unfold Flowsheet





HYDROTREATERS: Sea water is "softened" with dolomite in these three 125-ft.-dia, concrete tanks.





REACTORS: Dolomite and sea water three tanks. Two 75-ft.-dia. reactors of



THICKENER: Mg(OH)<sub>2</sub> slurry from reactors settles out in 250-ft.-dia. tank

▶ Process Innovations — By revamping reaction system to consist of two parallel-hooked reactors feeding a third, Kaiser doubled residence time for the reaction between sea water and dolomite that produces magnesium hydroxide. This gives Kaiser greater magnesia recovery. Further, by moving reaction streams through the system at lower velocities, Kaiser minimized carryover and loss of slow-reacting dolomite particles.

An improved countercurrent decantation system for fresh-water washing of magnesium hydroxide boosted product purity. Final CaO content has been cut from 1.5-1.75% to 1.0-1.35%; silica content sliced from 0.65-1.0% to 0.25-0.50%.

And Kaiser switched from cotton canvas to nylon cloth in its vacuum filter. Though nylon comes at a higher price, it outlasts cotton by some 3-5 times. Thus, this move netted substantial maintenance savings that overshadow added initial investment.

Too, thanks chiefly to the improved reaction and washing systems, heavier filter cake can be taken from filter cloth to calcining kilns. This hands Kaiser substantial fuel economies. And, installation of combustion meters on the kilns provided better burning control, so in-

sured uniform quality of magnesia products.

What Program Needed—Here's a rundown of the major new pieces of equipment and equipment changes that snared the process benefits and added capacity at Moss Landing.

Two 125-ft.-dia. hydrotreaters for pretreatment of sea water with dolomite were installed. Two existing 75-ft.-dia. hydrotreaters were converted to serve as reactors. A new 250-ft.-dia. settler, now in place, can be used either for thickening or washing magnesium hydroxide slurry. A 10-ft.-dia. by 235-ft.-long rotary kiln with a



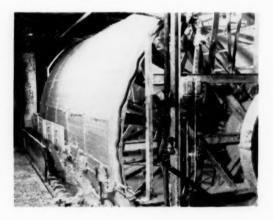
react to precipitate magnesium hydroxide in these perate in parallel, overflow to feed 60-ft.-dia. reactor.



VACUUM FILTER: Mg(OH): is filtered out on nylon cloth; taut wire scrapes it off onto traveling screw.



HYDROTREATER: Fresh water used to wash Mg(OH); is first softened here.



capacity of 150 tons/day was added. And a 35-in. redwood stave pipeline, with the necessary pumps, went in to handle the doubled seawater feed to the plant.

Product Variety—Along with the sea water, fresh water for washing and dolomite represent Kaiser's chief raw materials. Calcined dolomite, quarried, beneficiated and calcined at Kaiser's nearby Natividad installation, then trucked to Moss Landing, is reacted with sea water to precipitate magnesium hydroxide as a slurry. Slurry is washed with fresh water, then hydrate is filtered out.

Some of the magnesium hydrate

direct from the filter, still containing about 50% water, is homogenized and marketed as such. Rest goes through kilns to be "burned" to magnesia and manufactured into various grades of basic refractory brick.

► How Process Works—Sea water, pumped to a battery of three concrete 125-ft.-dia. hydrotreaters, is softened by adding enough callined dolomite to remove carbonates. In the case of sea-water dilution, caused by the heavy rains of the area that often last two and three weeks, a flocculating agent (Dow's Separan 2610) is added to the hydrotreaters.

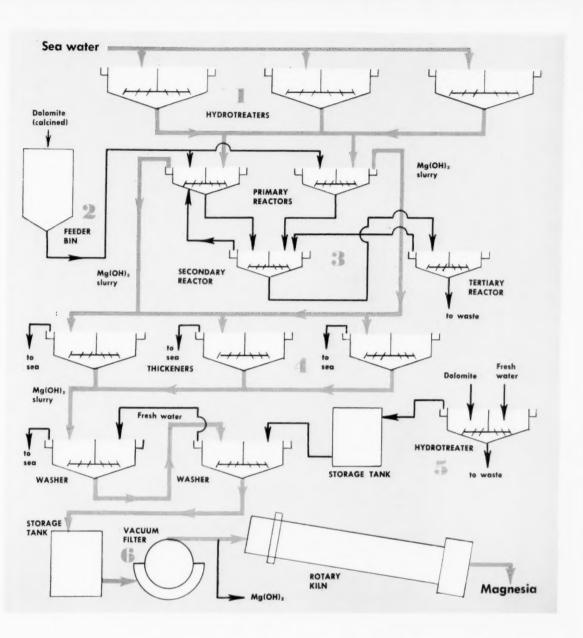
From these units, treated sea water flows to three reactors. First two 75-ft.-dia. tanks operate in parallel. They feed the third, a 60-ft.-dia. unit. Calcined dolomite, conveyed via a covered vibrating conveyer through feeder bins, is added to the two parallel reactors. Fine particles of magnesium hydroxide form, remain in suspension and are carried with overflow to the primary thickeners. Thickened hydroxide then goes to a freshwater, countercurrent wash and filtration.

► Less Speed, More Hydrate—Mixing energy in the reactors comes from the kinetic energy of the

enterir well a stream recycle terial) the bot a recta Silic dolomi

of the This ward v to surslow r time ar varied

actor s
► Thic



tering streams. At a junction ell ahead of each reactor, all reams (e.g., treated sea water, cycle underflow, calcined marial) join and enter reactor at e bottom and tangentially through rectangular pipe transition.

Siliceous material and unreacted lomite are pumped off the bottom the reactor.

This system permits a lower upind velocity of slurry from intake surface, reducing carry-over of ow reacting particles. Reaction me and flow pattern in reactor are ried by recycling overflow in re-

Thickening and Washing — Pri-

tor system.

mary thickening takes place in three 250-ft.-dia. parallel-flow settlers. After thickening, hydrate is washed. Two-stage countercurrent decantation occurs in two 250-ft.-dia. thickeners using treated fresh water. Then slurry is sent to storage.

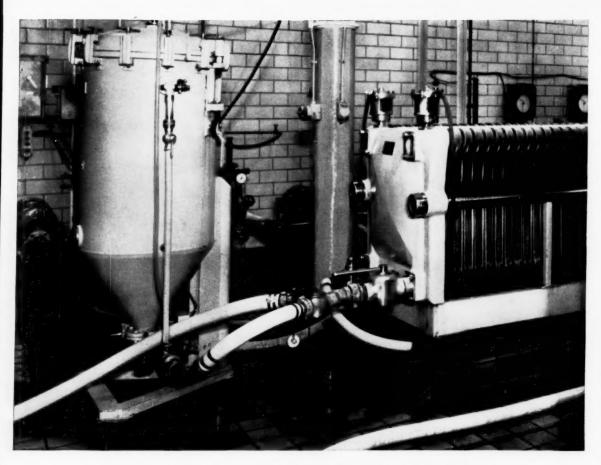
Before being used as wash, the fresh water is treated with dolomite in the same manner as the sea water.

► Filter and Calcine—From storage, slurry is pumped to 14-ft.-by-18-ft. nylon-cloth rotary vacuum filters, operating at about 22 in. of mercury. Magnesium hydroxide, filtered to about 50% water, is

scraped from the drum by a taut wire into a traveling screw below. Screw leads hydrate either to three rotary kilns or to bulk loading if material is to be marketed in hydrated form.

In the kilns, operating as high as 3,300 F., water is driven from the hydrate leaving the finished magnesia. Before entering kiln, magnesium hydroxide may be pepped up with finely divided silica as a sintering aid to produce high quality product.

Kaiser operates three kilns in order to get a high degree of process flexibility and turn out several grades of magnesia.



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## Chemical Engineering

## Practice

MARCH 24, 1958

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## Manufactured Gas . . .

Which processes will be used to supplement natural gas?

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Development of new or improved processes to manufacture fuel gas has claimed a hefty share of chemical engineering brainpower in the past few years. Mainspring of action has been utilities' conversion to pipeline-supplied natural gas for their base loads, begun after World War II and now claiming most of the nation.

But if manufactured gas has had a rebirth under the unlikely sponsorship of its successor, it is a new kind of manufactured gas demanding new production technology. Now in the role of substitute or supplement (for mixing with natural), manufactured gas must have properties which bring its performance as close as possible to that of natural.

Within the framework of this universal need for interchangeability, process aims have varied in accordance with two or three other specific needs. For short peak-load use, processes with small investment cost are required but expensive raw materials (LPG, light distillates) can be tolerated. For extended winter peak operation, or for very large utilities, you want a cheap raw material (heavy residual oil, coal) but can afford a large investment.

Some processes in the latter category would qualify for base-load status in the event of natural gas shortage. And some in the development stage are primarily aimed at base-load use. Long-range planning by the gas industry must consider alternate basic sources of high-Btu. gas, even though large reserves of natural gas are assured and disagreement still pre-

Light Peak Londs

Supplement may be made from light liquid fuels ... Materials are expensive but capital investment is low

Heavy peak loads:

Would use heavy liquid fuels . . . Less expensive but require higher investment

Eventual base loads:

Inexpensive coal fuel . . . Will need heavy investment

vails on the time when a replacement will be needed. Such planning recognizes that it is not total reserves, but the availability and cost of natural gas at the point of consumption, that is the criterion by which the need for natural gas substitutes should be judged.

Proved recoverable reserves of natural gas reached an all-time high of 237.8 trillion cu. ft. at the start of 1957. Even though net production climbed to a record of 10.9 trillion cu. ft. in 1956, a net increase of 14.1 trillion cu. ft. was attained.

Though many of the new manufactured gas processes aimed at base load use depend on heavy residual oil feed, present estimates of natural gas and petroleum reserves indicate that gas supplies are adequate for projected needs over an appreciably longer period than petroleum supplies. Hence coal-based processes have also come in for their share of development work. Coal is a natural

<sup>\*</sup> Meet your author on page 168.

choice because of the large reserves and their location within reach of the highly industrialized and most densely populated areas of the United States.

Interchangeability-In the prenatural gas era, heating values were of the order of 500-550 Btu., specific gravities ranged from 0.5 to 0.78 (compared to air) and chemical compositions varied considerably (coal gas and carburetted water gas). Natural gas, however, has quite uniform properties of about 1,000 Btu./cu. ft., a gravity of about 0.60 to 0.65, and consists of some 95% of methane. (Today only about 4% of the nation's utilities send out gas with Btu. content below that of natural.)

In the conversion to natural gas, the gas-consuming appliances of the customers are adjusted to produce a heat input and type of flame which are satisfactory both from combustion-efficiency and safety standpoints. So, manufactured substitute and supplementary gases must therefore be interchangeable with natural gas, that is, perform similarly to natural gas.

More Varied Feeds—While in the old days the main feed stocks for manufacture of utility gas were coal for coal gas, and coke and gas oil for carburetted water gas, today almost any liquid hydrocarbon suffices. Liquid petroleums through the whole gamut of petroleum refining products, from gasoline to heavy residues like Bunker C oil, can be converted to gas in specifically designed equipment. The conversion of coal to methane via catalytic treatment of synthesis gas is in an advanced stage of experimentation.

At the Institute of Gas Technology, for example, research sponsored by the American Gas Assn. has led to:

• Development of continuous pressure hydrogasification of liquid hydrocarbons, from propane to No. 1 furnace oil.

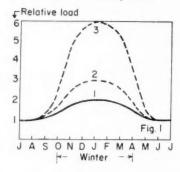
 Pilot planting of a cyclic high-Btu. oil-gas process for the hydrogasification of heavy residual oils.

• Bench testing of the complete conversion of Bunker C by highpressure hydrogasification.

• Pilot plants producing methane from coal via both oxygensteam gasification and direct hydrogenation.

Elsewhere, the UGI Cyclic Catalytic Reforming process as built by United Engineers & Constructors,

#### Winter hikes the utility load



Inc., has been developed and commercialized for use of light distillate feed in producing high Btu. gas. Using heavy oil for high-Btu. production, the very successful Hall process, based on a regenerative refractory furnace, was developed in the late 40's under American Gas Assn. sponsorship.

Economic Squeeze—Probably the most important factor in determining process and fuel is the relationship between natural gas supply and the characteristic annual load or sendout curve; the former involves the contract with the pipeline company (i.e., purchase price) and the latter is conditioned by the growing demand for gas for house-heating.

The diagram in Fig. 1 illustrates the effect of increasing heating load on the intensity of the "winter bulge." Curve (1) is typical of a large eastern seaboard utility prior to the natural gas era. Curve (2) depicts the same company today, while Curve (3) is typical of a large utility in northern U.S. at present.

From the foregoing curves it can be readily seen that if the natural gas were supplied in the quantities needed for the seasonal changes in load, the pipelines would be very poorly loaded in the summer and that would substantially increase the cost of natural gas. The utility must therefore contract for a reasonably constant quantity through the year (with some variations allowed) and provide for peak capacity ("peak-shaving") by other means.

The natural gas pipeline companies aiming for increased gas sales are bending all efforts to provide large capacity underground storage nearer the main consumption centers in order to be able to supply peak gas at more attractive prices,

and to keep their pipe facilities loaded in the summer for replenishing the storage.

The amount of gas actually in storage reached a new high of 1.5 trillion cu. ft. at the end of 1956. The industry is reported to have about 3.5 trillion cu. ft. capacity for storage—about one-third of present yearly consumption.

For the utilities, this means that the need for production of manufactured peak gas is likely to shrink, unless of course manufactured gas can be produced at lower over-all costs than storage.

For the present, a technical and economic evaluation is required to fit one or more of the available processes to specific conditions of duration and intensity of peak loads, operating and investment costs. Thus for extended winter peak operation an efficient process with low cost fuels would probably be preferable, even if the investment cost were high. Where peak days are few, the least investment is desirable, even though efficiency will fall and fuel cost will be high.

It is probable that the high capital investment required for the manufacture of gas from coal will dictate that gasification should be essentially a base-load operation. Solution to the substitute and supplement problems of the present and immediate future rests, therefore, on liquid and gaseous hydrocarbons.

Process Chemistry—Basically all liquid hydrocarbon-fed processes have one thing in common: They are a breaking down, i.e., a cracking or reforming of the constituent liquid hydrocarbons into gaseous hydrocarbons by application of heat. Many different reactions can occur but, in general, the end products are hydrogen, methane and carbon dioxide.

In making fuel gas today, broad process objectives are to get the highest percentage of gaseous product (rather than liquids or solids), with a heating value close to the 1,000 Btu's of natural gas, which is principally methane.

The ratio of hydrogen to carbon in the feed is a measure of gasification efficiency; the greater the ratio, the more gaseous products can be expected. The problem, then, is to add hydrogen or eliminate carbon to make the carbon-hydrogen ratio approach that of methane; the heavier the charge stock, the greater the required change in ratio.

#### New Processes for Manufacturing High Btu. Gas, Interchangeable With Natural

			Costs		Com-					Con-		
Fig. No.	Process	Feed	Raw Matt.	Invest- ment	mer-	Pilot Plant	Ther- mal	Cata- lytic	Cyclic	tinu-	Best Applications	Key Advantages
2	Hall, AGA	Bunker C down to naphtha	Low	Med.	V		$\checkmark$		V		Base load or ex- tended peak load (winter bulge).	Existing water gas machines can be readily adapted.
3	IGT hydrogasifica- tion of heavy re- sidual oil	Heavy residual oil	low	Med.		V	V		V		Base load or winter bulge.	Hall's advantages plus better inter- changeability of product gas with natural.
4	Surface Combustion Corp.'s Thermofor Catalytic Cracking	Heavy residual oil	Low	High		V	V			V	Base load if oil gas should become more competitive with natural.	Continuous remove of cracked product prevents clogging of offtake pipes.
	UGI modification of Cyclic Catalytic Reforming	Heavy residual oil	low	Med.		V		<b>√</b>	√		Base load or winter bulge.	High capacity, free dom from carbon accumulation on the catalyst.
5	IGT heavy oil-to methane via two hydrogenation steps	Heavy residual oil	Low	High		V		V		V	Base load.	Prehydrogenation avoids Conradson carbon deposition in second hydro- genation step.
6	Koppers-Hasche	Propane, butane, natural gasoline	High	Low	V		V			V	Peak load.	High production pe unit volume; low operating cost; quick startup.
7	UGI Cyclic Cata- lytic Reforming	LPG and kerosene	High	low	V			V	<b>V</b>		Peak load.	Substantial sulfur concentration can be tolerated in feed without catalyst contamination.
8	IGT pressure hydrogasification	Natural gasoline, light naphthas, kerosenes.	High	Low		V		V		V	Peak load.	Elimination of by- products minimizes handling and stor- age.
Coa	Processes										ARA A WAS ASSESSED ASSESSED.	**
Fig.	Process	Feed	Raw Matl.	invest-	Com- mer- cial	Pilot		Suspensi		Fixed Bed	Best Applications	Key Advantages
Ъ	IGT direct hydro- genation to methane	Bituminous coals, pretreated to pre- vent caking.	Low	Med.		V		V		Base load.		Reduces oxygen needs, purification steps.
0	IGT oxygen-steam gasification fol- lowed by meth- anation.	Bituminous coals, including caking varieties.	Low	High		V		V			Base load.	Low sensitivity to nature of coal used for feed.
1	Lurgi	Bituminous coals; promising potential for caking coals.	Low	High	V					V	Base load.	Fixed bed processe inherently more effi- cient than pulver- ized coal gasi- fication.
12	Flesch-DEMAG	Bituminous coals; promising potential	low	High		V				V	Base load.	Automatic renewal of fuel bed; does

Another parameter is the heat level applied; in general, the higher the heats, the lower the Btu. value of the resultant gas and the more solid carbon is produced. The use of catalysts in many processes has been found to be beneficial partly because catalysts seem to lower the temperature level at which the cracking reactions take place.

for caking coals.

Conradson carbon is the term

often, and rather loosely, used to describe non-vaporizable carbon residue which deposits in and clogs up process equipment. Getting rid of it is a universal problem in processing heavier hydrocarbon liquids.

Technical Squeeze—The processing techniques to choose from in handling these liquid hydrocarbons shake down into thermal vs. catalytic and under each of these headings

comes cyclic vs. continuous. Cyclic processes are patterned after the well established and proven watergas process in which a heating period (to provide the required cracking heat) alternates with a gas-making period, usually of about equal length. In continuous processes, heating and gas-making takes place simultaneously.

not use oxygen.

Examples of about every combina-

tion of these variables have been commercialized or have come under development during the past few years. Probably the ideal gas manufacturing process would be heavy oil fed, continuous and catalytic. But there's plenty of evidence that the ideal must still be strongly compromised.

Catalytic processes are superior to thermal because they more completely convert feed to product gas which means greater efficiency and less carbon deposition to clog up equipment.

Thermal processes have the advantage over catalytic when feed contains appreciable amounts of catalyst poisons like ash and the relatively large sulfur and vanadium content of heavy oil.

Continuous processes theoretically give more gas-making capacity for the initial investment, lend themselves to automation with its closer quality control and lower labor costs.

Cyclic processes have an advantage over continuous because of their ability to handle a much wider range of feedstock. For example, they accommodate removal of deposited carbon by oxidation during the heating cycle. Even at that, current processes can only handle oils with Conradson carbon contents of up to about 13%; the industry feels the optimum would be about 20%. In catalytic processes, catalyst can be regenerated during heating cycles by complete removal of carbon and sulfur.

#### Heavy Oil to Carry Tomorrow's Bulging Loads

Thermal and Cyclic—Institute of Gas Technology's cyclic high-Btu. oil gas pilot plant in Chicago, designed for the hydrogasification of heavy residual oils, lays several

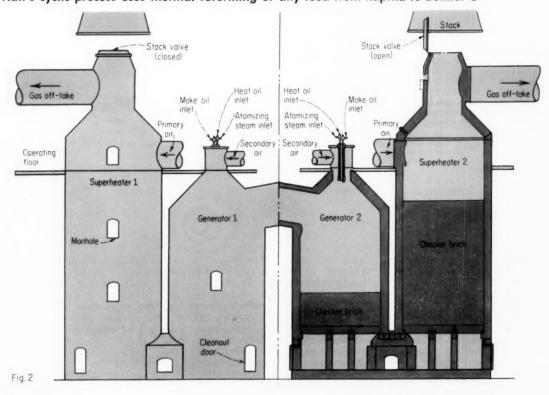
claims to a promising commercial future. Though still in the trialand- error stage, the process aims at using the lowest cost petroleum fractions available. It is patterned after and attempts to improve on the Hall process, possibly the most successful and versatile manufactured gas process commercialized since the nation-wide spread of natural gas.

Hall's is a cyclic, thermal-reforming process, shown in Fig. 2. It was the first to apply the regenerative principle to both the air and the steam in the production of high-Btu. gas from liquid fuels. Developed in the late 40's, it can feed on anything from naphtha to Bunker C and has been the basis for large-scale installations by such companies as Brooklyn Union Gas Co., Philadelphia Gas Co., Rochester Gas & Electric.

Designed primarily for the adaptation of water gas machines to the production of high-Btu. gas, the apparatus consists essentially of two pairs of four checker-brick-filled chambers, each comprising generator and superheater. They are arranged so that the regenerative principle can be applied by alternately heating and making gas.

For the first cycle, No. 2 gener-

#### Hall's cyclic process uses thermal reforming of any feed from naptha to Bunker C



ator and No. 2 superheater are heated to proper temperature by burning oil admitted to generator No. 2. Second, steam is admitted to superheater No. 1, and make oil is injected into generator No. 2. The mixture of steam and oil passes through No. 2 generator and No. 2 superheater, the oil is cracked to gas and passes to the washbox. In the second cycle, the two generator-superheater pairs reverse their function.

The gas train includes the usual carburetted water gas equipment. Of particular importance is the scrubbing and tar handling equipment, as considerable quantities of tar and light oils are produced during the process.

IGT's pilot plant process, Fig. 3, using a similar four-shell apparatus, attempts to improve on Hall:

Through the introduction of hydrogen gas with the feed, it seeks to achieve better interchangeability with natural gas by increasing yields of gaseous paraffins and reducing unsaturates in the product gas. Also, decrease in tar and carbon production increases the ratio of oil gas to feed.

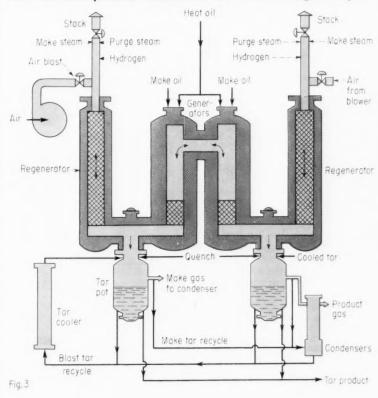
By providing adequate combustion space and oil gas residence time in the two generator shells, release of the heat requirements in the oil vaporizing and cracking spaces is assured. The two generators can handle the entire gasification load without dependence on the regenerators (called superheaters in the Hall process) to complete the cracking reaction.

The two regenerators are used only to preheat air and steam; the Hall process completes cracking in the regenerators. Because make products never pass through the regenerators, all deposited coke and pitch is confined to the generators, and the regenerators can be operated at higher temperatures. Absence of fouling makes it possible to obtain extremely high efficiencies in regenerator operation and to avoid smoke at the start of the blast without the use of an air purge.

A tar-quenching system using cooled product tar recirculation avoids use of the conventional wash box and provides a lighter, easierto-handle tar.

Thermal and Continuous —
Another approach to handling
heavy oil feeds is an adaptation
of Socony Vacuum's Thermofor
catalytic cracking process for pro-

#### IGT four-shell process reaches for better interchangeability



duction of gasoline. It has proved a technical success in a Toledo pilot plant of Surface Combustion Corp., Fig. 4. Called Thermofor pyrolytic cracking, it is a thermal process with many of its advantages based on the fact that it's continuous.

In the present economic setup, justification for the investment cost of TPC cannot be found in the relatively small units required for peak loads or peak-shaving. But its technical excellence is intriguing many gas industry production men because of its potential importance for larger installations if oil gas should become more competitive with natural gas.

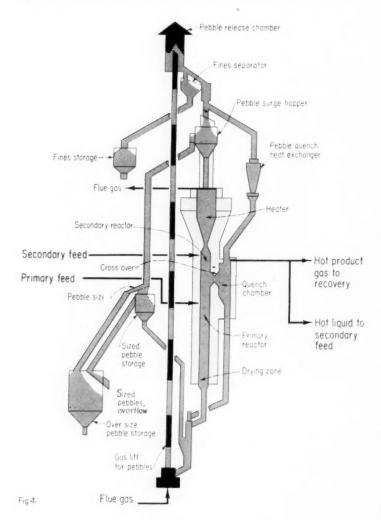
The process consists essentially in circulating two major streams of dense, hard petroleum coke pebbles. The main pebble stream flows downward through a series of vertical chambers including: the heater, where it is heated to cracking temperature; the reaction chamber where it is contacted with raw feedstock for vaporization and crack-

ing; the drying zone where final coking takes place. Pebbles emerging from the bottom enter a lift pot from which a continuous stream of flue gas returns them to the top of the unit to repeat the cycle.

A secondary stream of the coldest pebbles in the system is diverted through the line at the top of the unit and flows through a heat exchanger where provisions are available for controlling their temperatures at about 700 F., well below cracking temperature. These pebbles flow downward and enter the quench chamber. The hot gases and vapors which have been released in the cracking chamber enter the quench chamber at the crossover connection where they are quenched very rapidly to the temperature of the quench pebbles.

The quenched vapors then pass upward through the quench chamber and are removed from the unit through the product line. Quench pebbles join the stream from the reaction chamber, enter the lift pot

#### Thermofor pyrolytic cracking uses coke pebbles for heat transfer



and are raised to the top of the unit.

Continuous removal of cracked products from the system by means of the quench chamber eliminates a problem which has long plagued similar attempts at high temperature cracking with preheated solids. Previously, offtake pipes and chambers have always filled with deposits of coke and pitch.

The system works on any type of feedstock regardless of its carbon content. Coke pebbles serve both for heat transfer and as a depository for carbon laid down during the cracking. Any increase in volume is continuously removed from the system, so that the fact

that more carbon may be laid down than can be utilized for heat in the process is not a limitation since the excess is removed as a byproduct.

Catalytic and Cyclic — Though catalytic cracking has had most commercial success on feedstocks in the LP-gas to heavy naphtha range —usually in the production of low-btu. gas—at least two attempts to extend its use to cheaper, lower-cost feedstocks have reached the pilot plant stage.

United Gas Improvement, for example, is attacking the problem with a commercial-sized pilot unit in Philadelphia. This is a modifica-

tion of its cyclic catalytic reforming

apparatus which was originally adapted from the old water gas machines for commercial use on fuels from natural gas through naphtha and kerosene, to produce gases up to about 530 Btu.

Thus, the original CCR process represents a successful attempt to obtain the advantages of catalytic cracking or reforming, while at the same time retaining the heat transfer efficiencies of cyclic operation in heating the catalytic bed.

At UGI's heavy-oil-fed pilot plant, operating results thus far have been very encouraging for commercial operation. Starting with a standard two-shell CCR set—combustion chamber and catalyst-containing cracking chamber—developments include:

1. A special nickel catalyst specifically geared for use on heavy oil with, for example, its higher concentration of sulfur. Cyclic regeneration of the catalyst is accomplished during each heating cycle to eliminate sulfur poisoning of the nickel.

2. Vaporization of the oil prior to contact with the catalyst bed minimizes the deactivating glazing of the catalyst surface with ash from the oil. However, it is in this area that more development work is needed.

3. Changes in oil vaporizing surface and technique of operation have achieved complete consumption of Conradson carbon each cycle. Carbon contents of oils successfully tested on pilot scale have ranged up to 11%.

This last is probably the key phase in the development. It is a well-known fact that the capacity of a set to handle heavy oil, whether it be thermal or catalytic, is dependent to a large degree on its oil-vaporizing capacity. The oil-vaporizing capacity per cycle is usually limited by the amount of Conradson carbon that can be consumed each cycle, thus avoiding a gradual accumulation of carbon within the set.

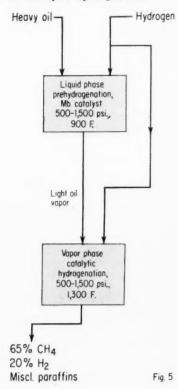
Contributing to the high capacity of the CCR process is a new technique of vaporizing the oil and of cracking it in separate steps. UGI researchers believe that this development assumes great importance in the cracking of heavy oil catalytically. If applied to a thermal oil gas set the same technique may result in more uniform cracking through better control.

Catalytic and Continuous-Insti-

tute of Gas Technology's AGA-sponsored approach, on the other hand, is via a continuous process with petroleum-industry influence. A pilot plant is now tuning up in Chicago to try a process (Fig. 5) which is based on application of a catalytic hydrogenation step to convert heavy residual oil back to premium oil feedstock. Residual is treated in the liquid phase under high pressure with molybdenum catalyst. A second hydrogenation step, in the vapor phase, converts the oil to methane.

The first step is based on the petroleum industry's hydrofining processes for upgrading residuum oils. Its primary purpose is to avoid Conradson carbon deposition in the second step. Hydrogen under pressure is passed through a fixed-bed catalyst, or catalyst suspended in the oil. The oil and hydrogen from this step then go directly and continuously to the final high-pressure, high-temperature step in a second catalyst chamber. High capital cost rules out peak load operation.

#### IGT heavy-oil process is based on catalytic hydrogenation



#### Premium Feeds Shave Today's Peaks

Thermal and Continuous — Directly counter to the situation in oilbased processing, most of the newer developments in processing lighter feeds have been catalytic. However, the Koppers-Hasche furnace (licensed by Koppers Co.), is an example of a thermal process which gained a healthy commercial foothold in the past few years.

This is a partial combustion, or autocaloric cracking process, which uses a special furnace (Fig. 6). Installations are producing a wide Bturange of gases from propane, butane or natural gasoline. Many of the installations are in the South where gas capacities required for peak loads or peak shaving are not so great as in the nation's heavily populated, colder sections.

Process advantages include: (1)
Low investment cost per unit of
thermal output. Very high rates of
production per unit volume of furnace are claimed. (2) Low operating
cost. The unit is subject to automatic control and requires a minimum of operating labor and supervision. (3) Quick startup. The
reformer can be put into operation
within 1 hr. from a cold start, or it
can be maintained ready for instant
service with a very small amount of
heat on automatic control.

Basically, the process brings preheated hydrocarbon feed into contact with a limited amount of air. Partial combustion of the hydrocarbon furnishes heat (>3,000 F.) to complete the thermal decomposition of the rest of the hydrocarbon. By regulating the proportions of hydrocarbons and air, the degree of the thermal cracking—and thus the product composition—can be controlled.

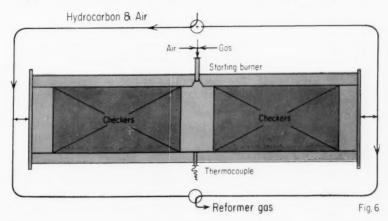
The furnace is rather long horizontally, with a rectangular cross-section. It contains a central, empty reaction space separated from the gas collection chambers at each end by a rather large section of high-purity alumina checkers.

Catalytic and Cyclic—One of the best known of the new light-distillate-fed processes is UGI's cyclic catalytic reforming. With 15 to 20 commercial units now operating on feedstocks ranging from natural gas through kerosene, the process is the starting point for UGI's previously described pilot plant work on a catalytic process for heavy oil.

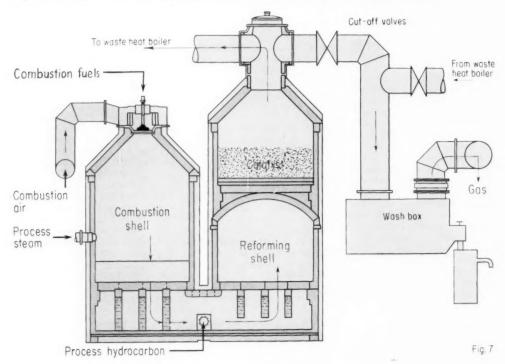
It was developed originally for adaptation of water-gas machines to the reforming of natural gas to produce high-hydrogen-content, low-Btu, diluent gas for mixing with other gases such as natural gas, LPG or coke-oven gas. Rebuilt water-gas machines, with a catalyst bed substituted for checker brick, proved so successful that specially designed sets (Fig. 7) have been developed. Commercial installations have used LPG and kerosene in regular operation, and diesel and Bunker C oils to a limited degree for production of 700 to 1,000 Btu.

Process advantages include: (1)

#### Koppers-Hasche process uses thermal reforming of light feeds



#### UGI's cyclic catalytic reforming process is used extensively for light distillates



Alternate heating of the catalyst bed with combustion gases containing excess air tends to keep the catalyst clean and active. In normal operation, carbon and sulfur are not deposited in the catalyst bed. (2) Substantial sulfur concentrations can be tolerated in the feedstock without adverse effect on catalyst activity. (3) On standby, the unit requires but 15 min. heating per day to maintain operating temperatures.

Equipment consists of a two-shell gas making train. The first shell is the combustion chamber in which hydrocarbon fuel is burned in order to heat the catalyst—porous alumina pebbles impregnated with nickel—in the second shell. The rest of the equipment includes wash-box, air blower, automatic equipment for controlling cycle changes.

Air and hydrocarbon feed are supplied to the combustion shell for heating, along with process steam. Natural gas and other process hydrocarbons can be fed into the tunnel connecting the two shells.

Catalytic and Continuous — A pressure hydrogasification process,

which is both continuous and catalytic, has reached pilot plant success in completely converting natural gasoline to a fully interchangeable substitute for natural gas. Originally developed by the Institute of Gas Technology in Chicago under the sponsorship of the East Ohio Gas Co., the process has been extended under the sponsorship of AGA to the processing of light naphthas and kerosenes. It aims at low investment cost for handling peaks.

Because it is continuous and because it eliminates any liquid or solid byproducts, the process keeps handling and storage costs at a minimum. The gas can be distributed directly to a high-pressure system without scrubbing. Further, a plant making several hundred thousand cubic feet per hour of gas can be operated by two people.

IGT's pilot plant is a tube furnace, Fig. 8, fired by gas-oil combination burners. It has three sections: the catalytic cracking section, the thermal cracking (hydrogasification) section, and the preheat section. Alloy steel tubes in

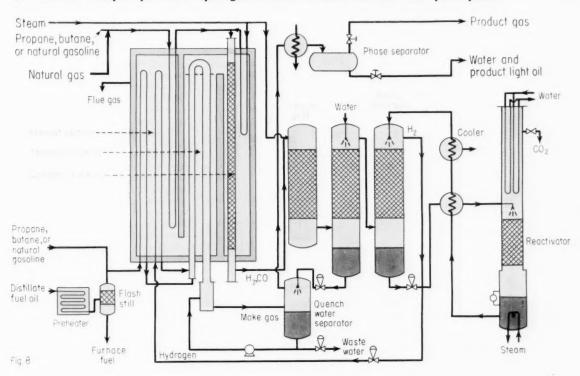
the catalytic cracking section produce hydrogen used in hydrogasification. These tubes are fed steam and either natural gas, recycled product gas, or natural gasoline vapor. Cracking conditions vary over a fairly wide range, but are in the neighborhood of 1,700 F. and 70 psig.

Gas from the catalytic cracking tubes contains principally hydrogen, carbon monoxide, and some carbon dioxide. Conversion of carbon monoxide to hydrogen and carbon dioxide is effected in a standard catalytic water-gas shift reaction chamber. Carbon dioxide is then removed from the product stream by absorption in monoethanol amine.

Depending on the type of raw material, the catalytic cracking section can turn out 10- to 12,000 cu. ft./hr. of gas containing over 90% hydrogen.

The hydrogen stream and natural gasoline or other feed stocks are fed to alloy steel tubes in the thermal cracking section. Hydrogasication takes place at about 1,350 F. and 65 psig., though these

#### Continuous catalytic pressure hydrogasification is basis of new IGT pilot plant



values, may vary over a fairly wide range.

Product gas is shock-quenched with water sprays upon leaving the thermal cracking tubes.

When using higher-boiling-range feedstocks (kerosene, No. 1 fuel

oil) for continuous pressure hydrogasification, some byproduct light oils—but no tar—are produced. These light oils can be used to provide the heat requirements of the process. Or, being high in benzene, they can be sold as byproduct.

#### Coal to Counter Ultimate Shortages

Basically, all coal-fed fuel gas processes are closer to syntheses, than the cracking and carbon-hydrogen reproportioning used for liquid-hydrocarbon-fed processes. Methane is synthesized via the more or less direct combination of its constituents, the carbon in coal and hydrogen gas. Processes aimed at high-Btu. fuel gas production are characterized by higher temperatures and lower pressures than those in which conditions favor high yields of liquid product.

Theoretical thermochemistry of three basic processes for conversion of coal to methane, as diagrammed by IGT, is shown in Fig. 9 (left to right): (a) Gasification of coal with oxygen and steam followed by

catalytic methanation and carbon dioxide removal; (b) partial hydrogenation of coal, followed by gasification of the residual char with oxygen and steam to meet the hydrogen requirements of the hydrogenation (not as yet at the pilot plant stage), with the hydrogen requirements met by catalytic reforming of a recycle stream of product gas followed by water gas shift and carbon dioxide removal.

Direct Hydrogenation — Coalbased processes aimed at the American economy, now or in the forseeable future: (1) Must be able to handle American coals, mainly caking bituminous coals; (2) must produce a fuel gas which approaches the high heating value of natural gas. In addition, of course, they should consist of a minimum number of process stages.

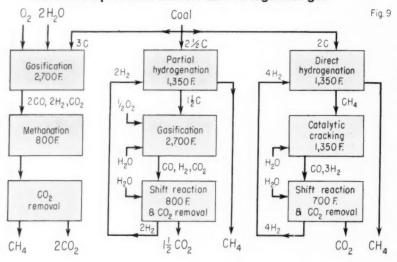
Probably the most ambitious attempt to date to fullfill these qualifications is represented by a pilot plant, just started up by IGT in Chicago, which uses direct hydrogenation on pretreated coal to produce essentially methane. (Central flowsheet, Fig. 9.)

Pretreated coal is fed to a hydrogenation reactor maintained at a temperature of about 1,300 F. and a pressure between 1,000 and 1,500 psi. Hydrogen is passed into this reactor to maintain the powdered coal in a fluidized condition and to react coal to produce 70 and 75% methane, plus some ethane.

Char left over from the hydrogenation step can be recycled to another unit. There, when treated with steam and oxygen at 2,500 to 3,000 F. under pressures between 100 and 400 psi., the char is converted to hydrogen for reuse in the process.

This process falls under the general heading of pulverized-coal gas-

#### Three basic processes convert coal to high-Btu. gas



ification, wherein coal particle sizes are in the order of 75 to 200 mesh, compared to \(\frac{3}{2}\)-in. pieces common to fixed bed processes. Pulverized-coal gasification is a very promising procedure for use in this country. Much pilot plant work has proved that all the difficulties stemming from caking propenty of bituminous coals are eliminated without any special equipment or sacrifice in capacity.

And most recent process development work in this country has fallen into this category. But it has been on processes whose basic nature demands at least two process stages. Unlike IGT's direct hydrogenation, the usual approach (Fig. 9, lefthand flowsheet) has been to gasify powdered coal with oxygen and steam under atmospheric or superatmospheric pressure to yield a high concentration of hydrogen and carbon monoxide. To upgrade such a product to 1,000-Btu. pipeline gas, it must be catalytically methanized and cleansed of CO.,

In contrast, IGT's direct hydrogenation approach to methane: (1) Reduces oxygen needs. (Cost of the oxygen plant plus compressor represents 25% of total investment costs.) (2) Eliminates elaborate and expensive methods of purifying synthesis gas before methanation.

As it stands now, the IGT direct hydrogenation is not a one-step process either. Though it would seem to have ultimate potential as such, it now demands feed coal pretreated at elevated temperatures with steam or inert gases to destroy caking properties and to prevent agglomeration and subsequent hydrogenation.

Oxygen-Steam Gasification—IGT also operates a pilot plant in Chicago based on oxygen-steam gasification, plus separate methanation. This pilot plant, Fig. 10, incorporates much know-how from earlier work.

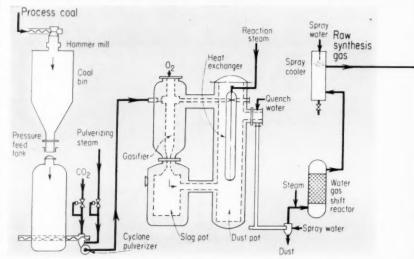
Coal gasification step at the IGT plant is carried out under slagging conditions at above-atmospheric Low-grade coal is repressure. duced to coarse granules, introduced into a carrier stream of compressed air and steam, which infiltrates the porous granules. When the resulting suspension is discharged through a nozzle into a cyclone chamber, gas-impregnated granules are ruptured by internal pressure, are further reduced in size by attrition of rapid vortical motion.

The coal-air-steam suspension and additional superheated steam are introduced separately into a second cyclone chamber atop the gasifier, where the fine coal particles are softened and partly devolatilized by partial combustion. The coal suspension is then mixed with compressed oxygen and passed into a reaction chamber in which 90-95% of the carbonaceous material is gasified at 5-7 atm. The ash flows as a molten slag into a catchpot.

Synthesis gas stream is waterscrubbed and cooled, then passed into a reactor where, with a Raney nickel catalyst, a gas consisting essentially of methane, carbon dioxide and water vapor is produced. The methanated gas then enters a glycol-amine purification system for final CO<sub>2</sub> removal and dehydration. The gas heating value is now 925 Btu./cu. ft. and, following compression, is suitable for pipeline use.

A fairly new group in the field of

#### IGT pilot plant employs oxygen-steam gasification of coal, followed



coal research is the natural gas pipeline companies. Because coal deposits are often located near those of natural gas or near pipeline routes, and because they have the ready-made transportation facilities that must be kept busy by one gas or another, such companies as El Paso Natural Gas have come to feel that they have a legitimate stake in coal research.

Among the other major groups concerned with experimental work on pulverized-coal gasification have been: the Fuel Research Station, Dept. of Scientific and Industrial Research, Great Britain; the Koppers Co., both in Germany and the United States; a mixed research group, Berghan-Verein, Ruhrgas A-G., and DEMAG in Germany; the U.S. Bureau of Mines; the Texas Co.

In addition to pulverized-coal gasification, there are two other basic principles of gasification which can be visualized as the foundation for a process to manufacture synthesis gas from American caking coals. These are: (1) The fixed-bed countercurrent system, operated at elevated or at atmospheric pressure, with oxygensteam blast, as exemplified by the

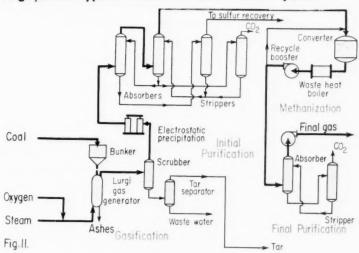
the Flesch-DEMAG process.

Fixed-Bed Countercurrent—The updraft countercurrent system, known as the Lurgi generator, is

Lurgi process; (2) fixed-bed down-

draft gasification as exemplified by

#### Lurgi process typifies fixed-bed counter current system



most advanced in its development. Fed by noncaking coals and usually for the production of liquid, rather than gaseous, fuels, commercial plants have been built by the Lurgi Co. (represented in the U.S. by Blaw-Knox) in Germany, Australia, Pakistan and South Africa.

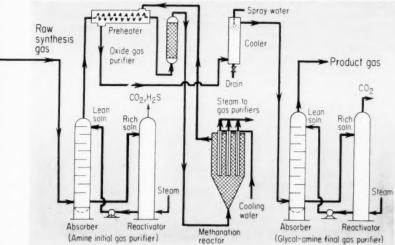
To accommodate needs of the American economy, development work aims at adaptation to strongly caking coals. In fixed beds, difficulties have been encountered with agglomeration of even weakly caking coals and with nonuniform fuel-bed temperature. However, fixed-bed processes are inherently more efficient than pulverized coal gasification.

In present commercial Lurgi installation, Fig. 11, feed is supplied under pressure to a fixed-bed pressure gasifier containing a rotary grate through which superheated steam and oxygen are fed. Exit gas under pressure is water washed to contain approximately 2% CO<sub>2</sub>, 23% CO, 59% H<sub>2</sub>, 15% CH<sub>4</sub> and C<sub>2</sub>H<sub>m</sub> with the balance nitrogen. Gas delivered has a heating value no higher than 450 Btu. and would have to be upgraded by methanation before use as high-Btu, pipeline gas.

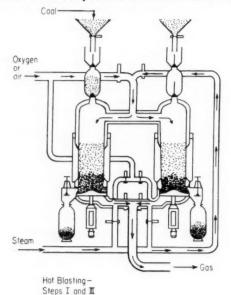
Fixed-Bed Down-Draft—The second type of fixed-bed process which might be adapted to American needs is down-draft gasification exemplified by the Flesch-DEMAG process, Fig. 12. Pre-eminent advantages of this type of process are its adaptability to a large variety of fuels. including caking coals, and the automatic renewal of the structure of the fuel bed through intermittent fluidization at short intervals. It eliminates the use of oxygen by a twin gasifier reversibly operated on heat and make gas periods. The process uses water-gas, rather than oxygen-steam operation.

A 100-ton/day pilot plant started up at Oppau, Germany, in 1953

by separate methanation\_\_\_\_\_ Fig. 10



#### Flesch-DEMAG process combines fixed and fluid bed operation



Oxygen Steam

Fig. 12

Fluidizing-Step II as shown; Step IV, flow reversed through vessels

produced at about 1 c. per 17,500 Btu. in gas heat. U. S. coals were not tested. The plant showed that all coals up to an ash content of 25% could be processed, as long as grain size was less than 8 mm. The first commerical generator, a \$400,-000 unit, is under construction by DEMAG at Zollverein Essen-Katernberg, in Essen.

The Flesch-DEMAG process is a continuous gasification process with cyclic feeding, devolatizing and declinkering. Equipment consists of two shafts connected at their upper ends with the necessary piping and valves. An automatic control system is used, similar to that of water-gas machine. The blast is admitted at the top of both shafts and the gas product is withdrawn through the rotary grates.

From time to time the flow direction in one of the two shafts is reversed, and the blast (or steam) is blown from below at a rate which fluidizes the inventory of this shaft. Thereupon the sticky clinker that has formed on top of the fuel bed breaks up, cools and solidifies, and falls down to the grate, from which it is continuously removed.

The fluidizing gases pass from the top of the first shaft through the connection duct and downwards through the hot fuel bed of the second shaft. During the fluidization, fresh fuel is fed into the fluidized bed, is intimately mixed with the inventory, is heated, devolatilized, and decaked. As soon as the lower valve is shut, the bed settles down, and gasification is resumed by admitting blast from the top again. Next, the second shaft is fluidized, and the operations repeated.

With respect to consumption figures, efficiency, and gas cost, processes of the Flesch-DEMAG type will resemble closely the countercurrent processes, except that there will be a slight decrease in efficiency caused by somewhat higher gas exit temperatures, and slightly higher investment cost for two shells and for the necessary connecting piping, valves and switching mechanism. Such increases may be balanced by the elimination of oxygen cost, if the Flesch-DEMAG process can be used as a cyclic water-gas machine.

In acknowledgement the author wishes to thank many individuals and organizations and, in particular: H. R. Batchelder, Battelle Memorial Institute; N. K. Chaney, American Gas Assn.; Sidney Katell, Bureau of Mines; C. A. Schlegel, United Engineers & Constructors, Inc.; Richard Schneiter, Consolidated Edison Co.; and W. E. Simmat, Koppers Co.

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## **Design for Low Construction Costs**

Chemical engineers should be familiar with the factors which affect chemical plant construction costs. By considering these points in process design, construction costs can be kept to a minimum.

#### R. C. ROHRDANZ, Tellepsen Petro-Chem Constructors, Houston, Texas\*

Whatever the reason for building or expanding chemical plants, final total cost of the new facilities is a governing factor which involves the chemical engineer. He is usually found in the midst of economic studies to determine feasibility and potential profit.

If cost determinations are approved by management, the chemical engineer goes to work on areas in which he has the greatest amount of formal education: development of flow sheets, coordination of the unit processes involved, sizing of standardized equipment and design of special process equipment.

To this point, the chemical engineer does not work alone. He is associated with sales and transportation specialists, as well as his fellow mechanical, electrical and structural engineers to some extent.

Past this point he starts to lose contact with the group of mechanical, electrical and structural engineers, who take on the responsibility for detailed design and construction.

But, next to management, the chemical engineering design group has more at stake in the cost of a completed plant than any other segment of the organization. To achieve the lowest plant costs, chemical engineers should work with, and advise, the structural, mechanical and electrical engineers. This cooperation should continue until final drawings are approved and specifications are complete.

To do this, chemical engineers should know something about how construction contracts affect costs, how contractors break down a job for estimating, how to design for savings during installation, how the writing of construction specifications can reduce costs.

This doesn't mean chemical engineers should work up detailed cost estimates. But if the methods used by the contractor are known, to chemical engineers, design can be controlled to result in low construction costs.

#### Four Factors Play Big Part

Know types of contracts available. An incentive contract is best. Where you don't have detailed engineering information, use the guaranteed maximum cost contract. Owner and contractor split difference between actual and guaranteed cost.

Know how contractor breaks down engineering information. If you know how he arrives at piping construction costs, you can include simplifications in the piping design to reduce these costs.

Know how equipment is erected. 14's much cheaper to install internal parts before erection, compared to installation after equipment is in place. Added weight of parts has little effect on erection costs for most equipment.

Know how to write specifications for the contractor. They should be simple and direct. Eliminate meaningless details. If a contractor has trouble interpreting specs, he will add a contingency factor, increasing the cost estimate.

#### **Know Construction Contracts**

Specifically, chemical engineers, as well as his associated engineers, will find it valuable to acquire a working knowledge of the types of contracts by which planned facilities can be designed and constructed, or only constructed. Our discussion assumes you have an engineering department that can turn out finished drawings and specifications.

Determining the type of contract best suited to a project is, in itself, a contribution to lower construction costs. And the selection of the most economical type of contract is dependent upon factors entirely within the control of the chemical engineer.

#### Incentive Type Is Best

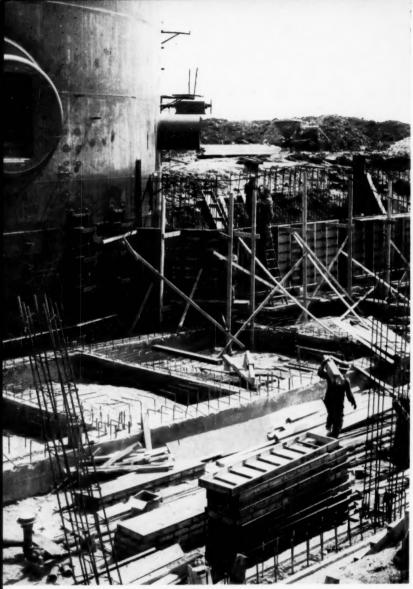
Incentive is one of the most important factors in human thinking. By proper incentive, the individual, or an organization of individuals, can produce the most for the least cost in dollars.

All things being equal, the straight "lump sum" type of contract offers the most incentive for the contractor; it's the simplest type of contract to administer, and usually results in the lowest cost plant and the best owner-contractor relationship.

This contract involves a single, mutually agreeable, fixed sum to do a well-defined job. It can be the result of competitive bidding by several qualified contractors, or the result of negotiation with a single selected contractor of known ability and integrity.

A lump sum contract can be used

<sup>\*</sup>Meet your author on page 170. This article is based on a paper delivered at a recent meeting of the South Texas section, AICHE, in Houston, Texas.



LOW CONCRETE COSTS (mostly labor) results from simple shapes and forms.

to contract design work only, construction only, or a combination design and construction project. It achieves maximum bilateral suc-cess when scope of the project is cleanly, clearly and thoroughly defined; when the owner has a good knowledge of contractor's planning; and when scheduling of the job is a combination effort of both parties to the contract.

#### **Guaranteed Cost**

Another incentive type contract is the "guaranteed maximum cost" contract with a split or shared savings clause.

This contract has particular

value where detailed engineering is incomplete and the owner recognizes that considerable contingency will be required.

There are several variations, but essentially it amounts to a guaranteed maximum cost negotiated by the two parties involved. All costs of the job are carefully accounted for. When completed, the difference between actual cost and guaranteed maximum cost is the saving, which is split between owner and contractor on a percentage basis. If there is an overrun, the contractor usually absorbs the full overrun amount.

A guaranteed maximum cost contract achieves the greatest suc-

cess when there is mutual understanding and mutual faith between the negotiating parties. It gives the owner incentive to do his share in reducing costs through elimination of all unnecessary frills, overdesign, and unnecessary slowness in approvals on design details and communications. It gives the contractor nearly as much incentive as the lump sum contract.

#### Useful Variations

A variation or modification of the above mentioned types of contracts often involves an early completion bonus clause or a bonus and penalty clause. This simply gives the contractor a bonus of a specified amount of money for each day he completes ahead of schedule, or penalizes him a specified amount of money for each day he fails to complete by schedule.

Although this variation gives incentive to both owner and contractor, it also presents hazards toward good relationships between

both parties.

Strikes, weather, material de-livery and labor supply are the major items affecting completion schedule, which often are hard to

There can be quite a variance in opinion as to methods of controlling these factors. The owner can have many thousands of dollars per day profit dependent on early completion, but not too much at stake on certain factors that are very important to the contractor, such as good construction labor relations and contractor association regulations.

Certain specific interests of the owner can possibly be directly opposite to specific interests of the contractor. On occasion, a bonuspenalty type of contract can strain good relations between parties to the contract.

Another variation of the guaranteed maximum type of contract: Contractor's profit and certain specified overheads are embodied in a fixed fee, while only the direct costs of the job are on a guaranteed maximum, split saving basis. This type of incentive contract has considerable merit.

#### NonIncentive Contracts

A type of nonincentive contract is the "cost plus a fee" contract. where the fee is either a percentage factor or a fixed amount.

This contract is usually used when true scope of the project is hard to define, or where the design and construction must be carried on simultaneously.

Quite often this is the only type of contract that can be written, in spite of the fact that it carries little if any incentive in the form of dollars. To a reputable contractor, however, it does offer a challenge to overcome certain inertia inherent in this type. And a chance to prove his ability and honesty to the client.

Fixed fees, which include contractor's profit and various kinds of overhead, are often negotiated with the cost plus contract. There must be a real desire for fairness on the part of both parties if good relationships are to be maintained. The fee should be fixed to a scope of reasonable limits, then adjusted to an underrun or overrun of the original target scope by specified increments of direct cost or time.

When determining the type of contract best suited to your project, remember that the contractor you select, by whatever method you use for selecting, should be a reputable contractor, financially sound and with experienced personnel. Such a contractor is a good business man and intends to be treated as such.

The reputable contractor operates on a surprisingly narrow margin of profit, contrary to the opinion of many that he makes a fabulous profit. His plant investment is much less than that of his clients, but the chances he takes to make a reasonable profit are all out of proportion to any other business operating with a comparable flow of capital.

#### **How Contractors Estimate**

Let us assume it is within your power to prepare a set of plans and specifications that can result in a lump sum type of construction contract. That being the case, you should know the contractor's approach to estimating cost of the work to be done.

Such knowledge, in turn, will cause you to direct the design along lines that will lead to lower construction costs—a contribution in the direction of lower total project costs.

First and foremost, you should know that a good contractor breaks down the information on the drawings to actual quantities of materials shown. All this he tabulates, summarizes and prices, often by competitive quotation. He makes every effort possible toward quantity buying, factory stock, mill shipment discounts and other means of savings. He makes no guesses at material quantities; he itemizes them down to the last nut and bolt required.

In a similar manner, he derives from the drawings every unit of work which requires labor. Here again, there is no guessing of work quantities that can actually be taken from the drawings. These work quantities are broken down into the smallest units of labor operation possible, or at least necessary for the labor estimate.

Amount of labor in manhours, for each unit of work required, is based on actual experienced cost of similar work, modified by conditions which will exist on a project

#### Concrete Breakdown

For example, ordinary earth excavation, for concrete foundations and substructures, will be estimated as a number of cubic yards. It will require the following information:

- 1. Equipment time (specific equipment best suited for the particular operation under the existing conditions).
- 2. Common labor time with specialized tools.
- 3. Common labor time with ordinary hand tools.
- 4. Fine grading time, if required
- quired.
  5. Sheet piling, shoring and
- platforming costs.
  6. Dewatering method and cost.
- 7. Backfill and tamping method and cost.
- 8. Spoil removal.

Reinforced concrete will be estimated by breaking down material and work units as follows:

- 1. Square feet of form in contact.
- 2. Board feet of forming material per contact foot,
- 3. Form ties and other accessories.
- 4. Shoring and bracing.
- 5. Stripping, cleaning, repair, removal of forms.

- 6. Reinforcing steel.
- 7. Tie-wire and accessories for reinforcement steel.
- 8. Anchor bolts and anchor bolt sleeves.
- 9. Miscellaneous iron such as trench angle.
  - 10. Placing concrete in forms.11. Finishing concrete in place.
- 12. Curing concrete in place. Many chemical engineers think of an empirical quantity of concrete to support a structure or equipment. The contractor develops detail quantities and costs. Approximately 20 items of cost are used to develop the final estimated cost of a cubic yard of concrete in place. Estimated cost per cubic yard will probably vary with every class of foundation poured under each process unit.

#### Piping Breakdown

For another example, assume that process piping in a process unit is being estimated. Each process line on the drawings is traced out from terminal point to terminal point, and the following quantities of material and/or labor developed for the detailed estimated cost:

- 1. Linear footage of straight pipe.
- 2. Composition and wall thickness of pipe.
- 3. Quantity and description of standard pipe fittings.
- 4. Quantity and description of special fittings and piping special-
- 5. Quantity and description of flanges.
- 6. Quantity and description of valves.
- 7. Quantity and type of gasket materials.
- 8. Quantity and type of flange bolting.
- 9. Linear inches of cutting, beveling and welding, and number of passes per weld.
- 10. Weight of pipe, fittings and flanges.
  - 11. Weight of valves.
- 12. Quantity and type of pipe supports, hangers and brackets.
- 13. Cost of X-ray or similar workmanship quality tests.
- 14. Cost of special metallurgical treatment.
- 15. Cost of hydrostatic or other pressure testing.
- 16. Cost of material handling.
- 17. Cost of scaffolding.



RIGGING COSTS come down when design provides for accessibility.

Compare this with an empirical cost of piping factored from process equipment costs, usually worked out by engineers making appropriation requests.

For the sake of brevity, we have outlined the contractor's approach to construction costs on only two simple phases of a job: reinforced concrete foundations and simple process piping.

#### Design for Low Cost

You as a chemical engineer should not be required to make a detailed cost estimate. But, as we stated before, if you know the methods used by the contractor, you can control design to accomplish the lowest possible construction costs.

To expand this point, refer back to reinforced concrete. Form costs, reinforcing steel cost, placing costs and finishing costs are the major items of cost in a cubic yard of concrete. Yet the in-place total cost can vary from \$20 to \$200 per cubic yard.

Form costs are a function of the square feet of contact surface; the greatest quantity of concrete that can be confined per square foot of form will contribute toward lower costs. Simplicity in shape requires a lesser amount of contact form footage per given volume of concrete, and also reduces the cost of fabrication and placing reinforcing steel.

Placing the concrete in the forms is a labor item. The quantity that can be poured in one operation, as well as accessibility and simplicity of forms and reinforcement, affect the placing cost to the extent of several hundred percent.

To take an extreme example, calculate for yourself the cost of a relatively simple mass of concrete of 200 cu. yd., confined in one simple form and placed in one operation. Compare this with 150 cu. yd. that will accomplish the same purpose, but is broken up into a dozen or more forms of various sizes and intricate shapes, poured in three or four operations.

Study your process equipment layout, your substructures and superstructures, as well as foundations of lesser importance, until you can achieve economies of this

While you are making such studies, exploit the use of concrete. It may be old fashioned, but it can be low cost, is fireproof and practically maintenance free. Use it wherever you can, and strive for simplicity in the design of it. Do not overdesign.

#### Piping Economies

A very large percentage of the cost of petrochemical or chemical process units is in piping. This cost is reflected largely in the quantity, size and type of joints; which in turn is based on the quantity, size and type of fittings, flanges and valves. Supporting the pipe and the labor of getting it into place, complete the major part of the piping cost. Here again, a thorough study culminating in simplicity is the answer to lower construction costs.

A long straight run of accessible pipe is always much less costly to install than a line with many fittings and joints. Economies result where many lines can be supported by common, simple supports.

Refer to the many units of work the contractor used to estimate piping cost and you will readily appreciate the need for simplicity in piping design. The simplicity needed here is largely a result of good equipment layout, as is the simplicity required in concrete foundations.

A small scale engineering model can often justify its costs many times over. It can improve the engineering with resultant savings in construction costs.

#### Lower Rigging Costs

Chemical process units differ in many ways and require specialized process equipment to a great degree. Yet, we believe the chemical engineer could standardize somewhat more than he does on certain types of equipment that are costly to manufacture as well as install.

The contractor's cost on process equipment comes usually in two separate and distinct phases. The first in unloading, hauling and rigging onto the foundation or into the structure. The second is assembly work, either internal, external or both.

Chemical engineers seldom consider rigging costs when making equipment layouts. Yet equipment accessibility, or lack of it, can be a factor that will double or even

triple rigging costs.

By comparison, we know of a major chemical company, which has standardized on one type of important process equipment, so the rigging procedure can also be standardized. They may have other reasons, but certainly their standardization results in lower rigging costs, lower assembly costs and lower foundation costs.

The second item of cost in process equipment erection is assembly. Here, also, chemical engineers can make a contribution to lower costs. As an example, if a fractionating column or similar piece of equipment of given dimensions, without internal parts, weighs 100 tons, it will cost a certain amount to rig into position. If it weighs a few tons more, due to internal parts already installed, it will cost very little, if any, more to rig into place. If those internal parts can be installed in the manufacturer's shop, or in the field while the vessel is horizontal on the ground, the labor saving will be very appreciable.

Installing internal parts on a vertical vessel from 50 to 200 ft. tall will probably cost two to three times more than if done on the ground. And that is not all the saving. If the vessel is rigged into place with internal assembly complete, there will be no delay in proceeding immediately with external process piping, thermal insulation and similar work to be done on the vessel

These are a few of the major and minor construction phases that we could cover, with similar suggestions for accomplishing economies.

#### Save With Specifications

Another area for cost savings concerns specifications.

An engineer who knows what he is doing can write simple, direct, to the point specifications that apply to his particular job.

If you want 3,000 psi, concrete at 28 days, your reputable contractor will guarantee that you get it and have laboratory proof to that effect. It does not take pages of specifications to tell him how to get it.

We have seen it necessary for an estimator to spend hours working through pages of specifications, trying to interpret the wants of the designer. Often there is misinterpretation, or at times doubt, that can only result in either contingency or mistakes, both of which are costly to the client.

In addition to these methods of reducing costs, remember one word which probably can do more to reduce construction costs than any other single item: "thoroughness" or "completeness."

Regardless of how simple or how complex your design, regardless of how small or how large your project, define the scope clearly, cleanly and thoroughly, with completely checked drawings and simple, to the point specifications.

To you, the chemical engineer, the scope may seem clearly defined, but do the drawings and specifications define it clearly to the bidding contractor? Or, putting it another way, are you, the chemical engineer, sure of the scope yourself? If not, how can the contractor know exactly on what he is bidding?

The contractor can only give a good estimate on what you clearly show on the drawings and define with words. If there is no doubt in the contractor's mind, there will be no contingency in his estimate. If there is doubt in his mind, the contingency will be directly proportional to the doubt.

It is usually within your power to reduce the contractor's contingency to an absolute minimum or eliminate it entirely. That is not all of the story. If drawings and specifications are extremely good, and the plant is designed for good construction planning, the estimated labor units will probably be lower. Conversely, if the drawings and specifications are not clear and concise, and the scope is not clearly defined in detail, then not only will higher labor units be used in the estimate, but a contingency will be

a necessity-all of which adds up to higher contract costs.

#### What Can You Do?

To this point, we have emphasized methods of lowering construction costs when the client provides the engineering and an incentive type contract is used. To repeat and to summarize, the chemical engineer can contribute greatly to reduced construction costs as follows:

· Be well acquainted with the different types of contracts and aim toward the use of incentive type-incentive for owner or client

as well as contractor.

· Know the contractor's approach to cost estimating on a project. This knowledge will cause the engineer to incorporate features of design and simplicity that will result in lower construction costs.

· Develop good, complete drawings and to the point specifications. Do not overdesign. Let simplicity

be your watchword.

· Above all, be thorough and complete, and define the scope well, in detail with drawings and words.

When you have a contractor design as well as construct your project, the following items are essential to lower costs, and are within your control:

· Know the scope, know it well, and define it clearly.

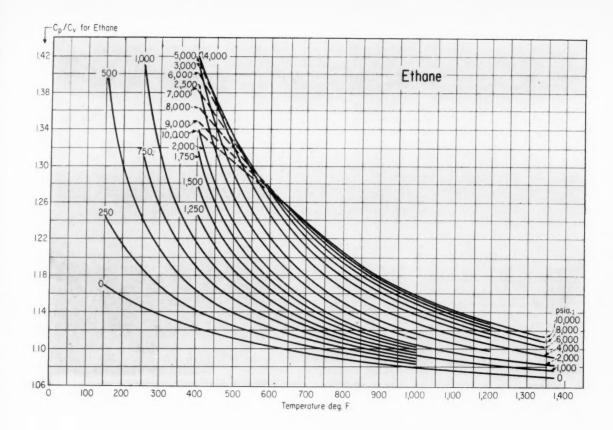
and Promptly adequately furnish required process data, as well as all other design information, to your contractor.

· Promptly approve, or constructively criticize, flow sheets and other information submitted to you for approval.

· Promptness on your part will give the contractor confidence in you and your organization. Mutual confidence and respect are a must.

Added effort, resulting in good drawings and specifications, a well defined scope, and promptness in communications, will save enough money on the construction phase to more than pay for the entire cost of the engineering phase.

It does not require the higher mathematics and complex formulae you were taught in school to achieve economy in construction. It requires only simple arithmetic, a working knowledge of the contractor's problems and methods, and a real desire for mutual understanding.



## Heat Capacity Ratios—5 Hydrocarbons

Use these new graphs to determine accurate values of the heat capacity ratios. Wide range of temperature and pressure given for  $C_P/C_V$  ratio increases its usefulness in many applications.

#### JOSEPH JOFFE and E. G. DELANEY, Newark College of Engineering, Newark, N. J. \*

Heat capacity of an ideal gas is a function of its temperature only. For real gases, high pressures have a marked effect on the isobaric heat capacity and a lesser effect on the constant-volume heat capacity. As a result, the heat capacity ratio  $C_{\nu}/C_{\nu}$  of real gases varies considerably with pressure.

The effect of temperature on the heat capacities of a number of gases at low pressure has been adequately explored. Accurate data are available on the heat capacities of light hydrocarbon gases in the ideal gaseous state corresponding to low

pressures. These data are in the publications of the American Petroleum Institute Research Project 44°

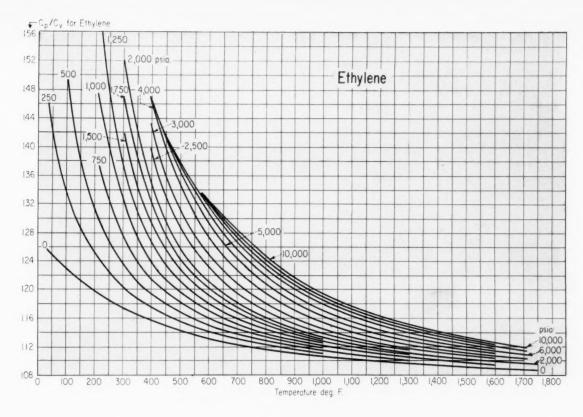
On the other hand, there are very few experimental data on heat capacities of light hydrocarbon gases. I at high pressures. However, only limited temperature and pressure ranges have been covered for these gases. The lack of experimental data requires the use of generalized correlations of *P-V-T* properties and of equations of state to calculate the effect of pressure on the heat capacity."

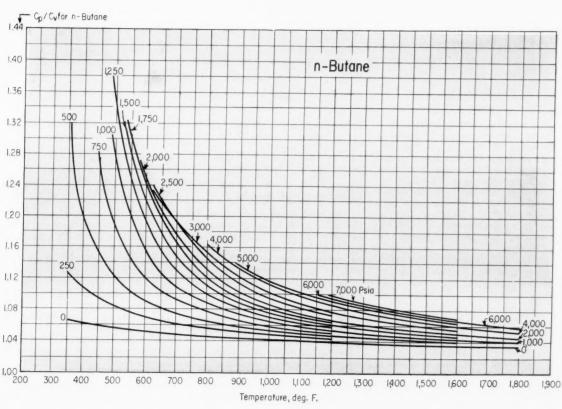
Most of the published data deal with the effect of pressure on the isobaric heat capacity. Essentially this same approach has been used to correlate the ratio  $C_v/C_v$ .

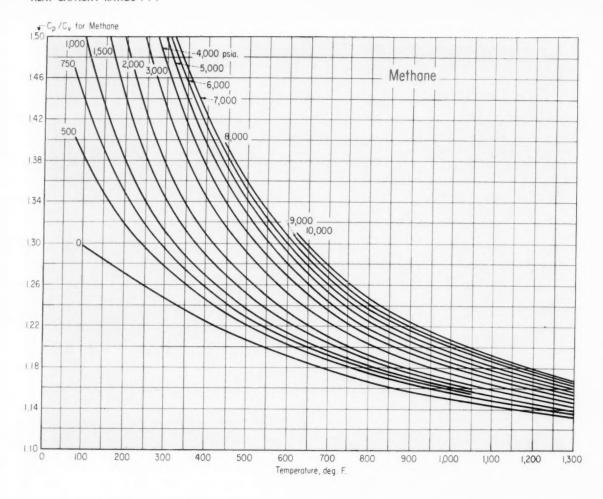
Edmister uses two generalized correlations, one of  $C_p - C_p^*$  the other of  $C_p - C_v$  vs. reduced pressure and reduced temperature. He uses these correlations to evaluate the specific heat ratios of 17 hydrocarbons. up to a reduced pressure of 1.2 and a reduced temperature of 2.5.

Generalized correlations of heat capacities are inherently less accurate than heat capacity values derived for each hydrocarbon from its specific P-V-T data. Accordingly, a program was undertaken at the Newark College of Engineering to calculate the  $C_p$  —  $C_p^*$  values

<sup>\*</sup>E. W. Sledjeski and T. A. Reiter are also contributors to this article.







for several light hydrocarbons using the Benedict-Webb-Rubin equation of state.  $^{10}$ 

The results\*.° for methane and for propane have been published. Other hydrocarbons for which calculations have been completed are ethane, ethylene, propylene and n-butane. The calculation\* of  $C_p - C_p$ \* using the Benedict-Webb-Rubin equation has been previously described.

Since  $C_{\mathfrak{p}}-C_{\mathfrak{v}}$  is found as an intermediate step in the calculation, values of  $C_{\mathfrak{p}}/C_{\mathfrak{v}}$  are easily computed. For each hydrocarbon, values of  $C_{\mathfrak{p}}$  can be obtained by adding to  $C_{\mathfrak{p}}-C_{\mathfrak{p}}^*$  the ideal-gas heat capacity  $C_{\mathfrak{p}}^*$  for which API Project 44 data are available.  $C_{\mathfrak{v}}$  is found by subtracting the values of  $C_{\mathfrak{p}}-C_{\mathfrak{v}}$  from  $C_{\mathfrak{p}}$ . The ratio of  $C_{\mathfrak{p}}/C_{\mathfrak{v}}$  is then calculated.

These calculations have been performed for five hydrocarbons:

methane, ethylene, ethane, propane and n-butane. Graphs of the ratio  $C_{\rm p}/C_{\rm e}$  vs. temperature with pressure as a parameter have been prepared and are shown here.

#### Comparison of Results

No direct experimental data for the  $C_{\scriptscriptstyle p}/C_{\scriptscriptstyle v}$  ratios of hydrocarbons at pressures above atmospheric are available for comparison with the values presented here. The deviation of the constant-volume heat capacity  $C_{\scriptscriptstyle v}$  from the ideal-gas value  $C_{\scriptscriptstyle v}^*$  is considerably less than the deviation of  $C_{\scriptscriptstyle p}$  from  $C_{\scriptscriptstyle p}^*$  at the same temperature and pressure.

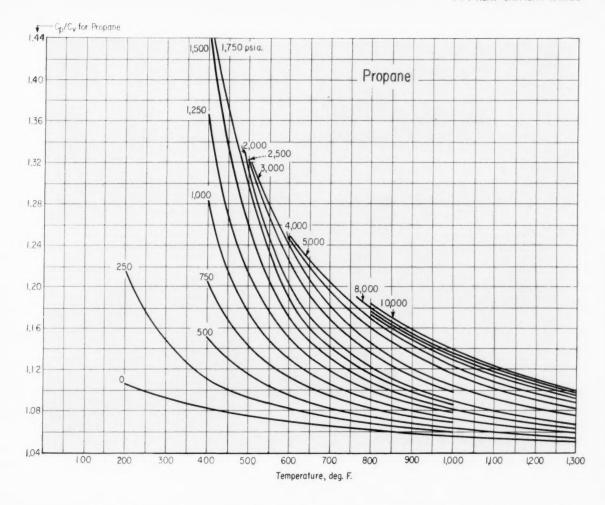
Accordingly, it may be assumed that the percent error in the calculated  $C_{\nu}/C_{\nu}$  ratios is of the same order of magnitude as the percent error in the corresponding values of the isobaric heat capacity  $C_{\nu}$ .

Estimation of the accuracy of

the calculated  $C_p$  values is hampered by the existence of only a very limited amount of data over narrow temperature and pressure ranges. Also the existing data is obtained from Joule-Thomson computations rather than by direct heat capacity measurements.

In the case of methane," agreement with isobaric heat capacities derived from Joule-Thomson data is good above 200 F. For ethane and propane, agreement is not quite so good. However, some doubt exists as to the accuracy of the Joule-Thomson determinations. No satisfactory comparative data are available in the literature for ethylene and n-butane.

Previous to the present work, Edmister published a chart of the heat capacity ratios of 17 hydrocarbons<sup>5,4</sup> based on generalized correlations of  $C_p - C_p^*$  and  $C_p - C_r$ . On the whole, there is good



agreement between the values of  $C_v/C_v$  read from the Edmister chart and those given here. However, results obtained for any given hydrocarbon from generalized charts are inherently less accurate than those based on specific data for each hydrocarbon.

#### Uses of Heat Capacity Ratio

The heat capacity ratio (k or  $C_p/C_v$ ) of an ideal gas is useful in calculating the isentropic work of compression by the following for-

$$-W_{*} = \frac{k}{k-1} P_{1}V_{1} \left[ (P_{2}/P_{1})^{(k-1)/k} - 1 \right]$$

Any text in engineering thermodynamics shows the derivation of the formula. This formula should not be used for calculating the isentropic work for a real gas which

#### Nomenclature.

- Constant-pressure heat capacity. Constant-pressure heat capacity
- in the ideal gaseous state. Constant-volume heat capacity.
- Constant-volume heat capacity in the ideal gaseous state.
- Ratio of Cp/Cr.
- Absolute pressure.
- Volume handled by compressor. -W. Isentropic work of compressor.

#### Subscripts

- Suction conditions.
- Discharge conditions.

shows appreciable deviation from the ideal gas laws.5

These charts of heat capacity ratio  $C_{\nu}/C_{\nu}$  are helpful to estimate the operating range over which the above formula gives approximately correct results.

Regardless of whether a gas is ideal or not, the specific heat ratio  $C_p/C_v$  gives the ratio of the slope of the isentropic curve to that of the isothermal curve intersecting it at any given point on the P-V plane. As Edmister points out, specific heat ratios of real gases have other applications as well.

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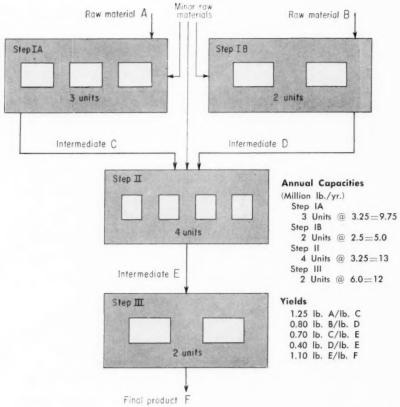


Fig. 1

## Plant Operations Are Easier to Visualize

#### Make a conversion chart for your own plant. It'll give you an over-all view of opera-

By J. B. Charlton\* Engineering Div. Chemstrand Corp. Pensacola, Fla.

Whether you're in operations, development, design, economics or management, chances are that visualization problems occupy a good percentage of your day. Of these problems, one of the hardest to understand lucidly is interrelations between various plant yields and capacities. This is especially true for a multi-step, multiple-unit processing plant. Charts can relieve you of some of this burden. Spend just a few hours, pencil and ruler in hand, and you may be

amazed at the time, effort and possibly money you'll eventually save.

For most multi-step chemical processing plants, it's possible to construct conversion charts that will quickly show:

• Raw material requirements at various production levels.

Quantities of each intermediate product required at various production levels.

 Capacity of each major production unit in terms of equivalent final product.

 Process steps, if any, bottlenecking existing total plant capacity.

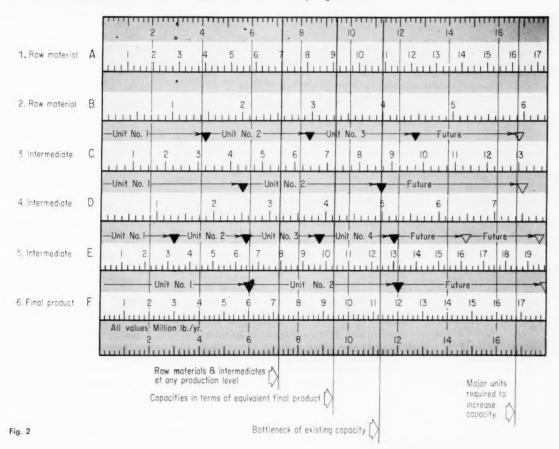
• Number of major production units required to increase plant capacity to a higher well-balanced

We'll use the XYZ Chemical Co. to illustrate possible applications of such a chart, and the general method for its construction.

A flow diagram for the example plant, together with related yield and capacity data, is presented in Fig. 1. Assuming constant linear relationships at the various production levels, this information provides a basis for calculating answers to a number of specific questions related to yields and capacities. To obtain a desired answer, however, we must perform at least one and possibly a series of calculations.

<sup>·</sup> Meet your author on page 168.

## . . . a conversion chart will answer many questions



## When You Use a Yield and Capacity Chart

## tions. This graphic tool will also put much vital data at your fingertips.

For example, let's determine the quantity of raw material A required for 6 million lb./yr. of final product F:

Required raw material A

= 6,000,000 lb./yr. 
$$F \times \frac{1.10 \text{ lb. } E}{\text{lb. } F}$$

$$\times \frac{0.70 \text{ lb. } C}{\text{lb. } E} \times \frac{1.25 \text{ lb. } A}{\text{lb. } C}$$

= 5,780,000 lb./yr.

Lack of time and the inherent possibility of error usually prohibit large-scale repetition of this type of calculation. Consequently, the chart in Fig. 2 was devised to give quick yield and capacity information, while at the same time reducing the possibility of error.

With the general scheme of flows for XYZ in mind, we can readily get answers to a number of questions from Fig. 2. To illustrate the manner in which the chart is read, let's again determine the quantity of raw material A that will be required for 6 million lb./yr. of F.

The top and bottom scales of Fig. 2 are calibrated in millions of pounds per year of F; all the intermediate horizontal scales represent existing process relationships. A straight line between 6.0 on the top scale and 6.0 on the bottom scale intersects the horizontal scale representing A at 5.8 (5,800,000 lb./yr.). This answer checks the pre-

viously calculated figure of 5.78 within the limits of graphical accuracy for a chart of this size.

Bearing in mind that all process equivalents are aligned vertically on the chart, further inspection reveals that:

1. The three major production units in Step IA have a total capacity equivalent to 12.7 million lb./yr. of F.

2. Step IB bottlenecks the plant at a capacity of about 11.4 million lb./yr. of *F*.

3. Entire plant capacity could be increased to a fairly well balanced operation at 16.9 million lb./yr. by the addition of one production unit in all process areas except

Step II, which would need two additional units. If we make these changes, Step IA (now the bottleneck) and Step IB become lucrative targets for process development effort. Increases in both of these steps to an equivalent annual production of 17.7 million lb. of F would complement capacity otherwise latent in Steps II and III.

Now that we've gone over some of the possible uses of this chart, a discussion of its detailed construction may be of value to those foreseeing potential application.

#### Here's how to make it

The first logical step in preparing the yield and capacity chart is selection of what we want to show. Fig. 2 presents the following information for the XYZ Chemical Co. in terms of final product:

- Quantities of raw materials
   A and B required.
- Quantities of intermediate products C, D and E in transition.
- Capacities of each major production unit.

Yield and capacity data are usually available directly from existing plant records. Essential data for the XYZ plant are tabulated at the right of Fig. 1.

We can now define the exact form for portrayal of the process data. Top and bottom scales of the chart represent the material or item having the most significant relationship to each of the other items shown on the intermediate horizontal scales. Since process information for the XYZ plant (and all other plants, normally) relates most significantly to material produced, final product F is shown on both extreme scales of Fig. 2.

Careful selection of scale units best serving the envisioned purposes of the chart will save time in the long run. Millions of annual pounds (as in Fig. 2), pounds per day, pounds per hour, or other unit rates may be handled with equal facility.

The scale length in Fig. 2 was chosen solely by virtue of its convenient printing size. A chart this small is adequate for many applications. Larger charts, however, afford better graphical accuracy and allow construction of more internal horizontal scales. Charts 22

x 34 in. in size have been used quite satisfactorily.

The exact range covered by the top and bottom scales is an arbitrary choice dependent upon the particular situation being portrayed. The range of 0 to 18 million lb./yr. for the XYZ plant was set for the purpose of covering existing plant capacity and the probable range of capacity increases which might be justifiably considered.

After top and bottom scales are established, the internal scales may be constructed. In addition to the information presented on Fig. 2, it's sometimes desirable to include such things as utility and minor raw materials requirements. Utilities are handled readily on these charts, with separate horizontal scales depicting steam consumption, electricity, cooling water, etc. Over-all chart height, however, is often the limiting factor to the actual number of scales shown.

Scale No. 1, representing raw material A in Fig. 2, will be considered as an example for developing the equivalent linear scales. The amount of A required per unit of final product F must be determined. From Fig. 1, data may be obtained for the calculation:

$$\begin{split} \frac{\text{Lb. }A}{\text{Lb. }F} &= \frac{1.25 \text{ lb. }A}{\text{lb. }C} \times \frac{0.70 \text{ lb. }C}{\text{lb. }E} \\ &\times \frac{1.10 \text{ lb. }E}{\text{lb. }F} = 0.963 \end{split}$$

In order to construct the entire calibration of Scale No. 1, we must somehow fix the first point on it. We can establish the location of 10 million lb./yr. of A as follows:

Lb. F equivalent to 10,000,000 lb. A

= 
$$\frac{1}{0.963} \times 10,000,000$$
 lb.  $A$   
=  $10,380,000$  lb.

Consequently, the 10.0 point on Scale No. 1 falls in vertical alignment with 10.38 on the top and bottom scales. Once we've spotted the 10.0 point, subdivision of the scale into equal increments is easy. Draftsman's dividers facilitate the operation.

After linear calibrations are constructed for all the horizontal scales, capacities of the major production units can be sketched in quite readily. Annual capacities for units of the XYZ plant are tabulated in Fig. 1, and appear on the scales of Fig. 2 as triangular markers. Shaded and outlined

symbols distinguish between existing and future production units.

Thus completed, the chart should be thoroughly checked to assure its accuracy.

## Check it out carefully

Check each horizontal bar at several points by comparing calculated values with those read from the chart. For example, how much E is required for 8 million lb./yr. of F? The calculated amount is:

Lb. 
$$E = \frac{1.10 \text{ lb. } E}{\text{lb. } F} \times 8,000,000$$
  
= 8,800,000

Aligning a straightedge between 8.0 on both top and bottom scales, we read the same approximate value for E, 8.8, on Scale No. 5. Hence, the accuracy of the chart for this particular point is satisfactory. Once completed and thoroughly checked, a yield and capacity chart potentially can repay the effort of construction many times.

The example, XYZ Chemical Co., was simplified only for purposes of clearer explanation. Beneficial use of a chart of this type actually increases in direct proportion to the complexity of the plant being considered.

#### Additional Applications

Additional applications for conversion charts are often encountered in the design and construction of a new plant.

If design calls for the installation of major equipment items of fixed capacity to a multi-process plant, for instance, the graphical treatment clearly shows when the various process capacities are well balanced. This leads to optimum utilization of the installed capacity in each process step.

In plant construction, proper choice of completion dates makes it possible to increase capacity at the theoretically maximum rate. We can resort to the yield and capacity chart for help in establishing a good completion sequence for the various process units undergoing construction. In the buildup from zero to total plant capacity, the units should go on stream in the same order that they bottleneck operations. Bottlenecks show up glaringly on a yield and capacity chart. Here again, then, the charts can be of great value.

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Begin First Installment on . . .

## **Mass Transfer Operations**

by JAMES O. OSBURN State University of Iowa, Iowa City, Ia.\*

M ost processes at some point use mass transfer operations such as distillation, absorption and extraction. To operate these processes most economically, we must keep up with the latest equipment for mass transfer operations.

An understanding of the underlying principles of mass transfer is often helpful for the intelligent selection and application of processing equipment.

For these reasons, this refresher on mass transfer operations can help you. We'll start by examining the operations themselves. Then, we'll review the basic principles of mass transfer; and later show how these are used in equipment design.

### Why Mass Transfer Is Important

When you graduated, you wanted to keep up with all the latest developments of chemical engineering. But with a full-time job in the plant, this becomes harder and harder to do. When we think about how much time and money is going into research each year, it's easy to see what's happening. Information and theory about chemical engineering are piling up beyond anyone's capacity to absorb it all.

This process has been going on for quite a while. The situation would be out of hand already, except for an opposing trend. This is the trend toward basic understanding of physical facts. As we discover more and more facts, we are able to fit these together in generalizations which greatly simplify our understanding of these facts.

The organization of industrial chemical practice into the unit operations is an example of this advance toward basic understanding. Unit operations helped the engineer to understand a large number of previously unrelated facts, and hence increased his usefulness.

Now as we learn more about the different unit operations, we can understand them better by grouping together those that have a similar mechanism. This is what we do when we consider the mass transfer operations. We study these operations together to discover their basic similarities and also how their differences are handled.

Beyond this treatment is the new concept of science engineering, which reduces all the unit operations to a number of differential equations, describing the motion of matter and energy. This new concept undoubtedly will lead to a greater simplification of chemical engineering.

\*Meet your author p. 169.

## Your New Series Will Cover...

Theory Driving forces

Rate equations

Calculations using Transfer Coefficients Theoretical Contacts Equilibrium Stages Transfer Units Liquid-liquid Extraction Liquid thermal diffusion

Liquid-solid Dissolving Crystallization

Liquid-vapor Distillation

Liquid-gas Gas absorption

Solid-vapor Sublimation

Adsorption
Solid-solid

Solid diffusion

Gas diffusion

Gas diffusion Thermal diffusion Solid-liquid-solid

Leaching

Solid-liquid-vapor Adsorption

### What Are Mass Transfer Operations?

We can identify a mass transfer operation if

- There are two or more phases in contact.
- · Material flows from one phase to another.
- At least part of the flow is by molecular motion or diffusion.

Because the basic mechanism is the same, there are many similarities between the different operations. We'll describe some of these similarities a little later.

There are differences, too. That's why we have different names for the various operations, and why we can't treat them all exactly alike. When we study one of the mass transfer operations it's very important to understand the others; as well as to know the general properties that all the mass transfer operations have in common.

## Phase Type Affects Mass Transfer

In mass transfer, we find motion from one phase to another. We expect the nature of the phase to make a difference, and it does. Phases may be

 Solid with high density, limited mobility and slow molecular motion.

· Liquid usually somewhat less dense, with

greater mobility and more rapid molecular motion.

 Gas or vapor with much lower density, greater mobilty and very rapid molecular motion.

Each of these properties has an effect on mass transfer when we consider the total picture of an operation.

The density determines how many molecules can exist at the interface and how fast diffusion takes place within a phase. It also has an influence on the difficulty of getting intimate contact between phases and on their separation.

The mobility tells how easy it is to stir a phase. If it is easy, then we can help mass transfer by causing turbulence within a phase. However, we have to avoid making mixtures that won't separate.

Because much of mass transfer is by molecular motion, the rate of molecular motion has a lot to do with the rate of mass transfer. We get quite a large range of rates, determined in part by the rates of molecular motion within the phases.

## Other Differences May Be Significant

We find other differences when we analyze the different mass transfer operations. One of these is in the number of components. Certain operations are often carried out with only two active components. These operations are distillation, thermal diffusion, adsorption, gas diffusion and leaching.

We find these operations are also used with three or more components. Operations such as extraction and gas absorption almost always involve three or more components.

Often, calculations are simplified when the components are not completely distributed between phases. Some of the operations such as leaching and adsorption are carried out in the presence of a solid that is more or less inert. This means that it appears in only one phase.

When we deal with gas absorption, we usually find that the solvent doesn't appear in the vapor phase, nor does the carrier gas dissolve in the solvent. In extraction, the solvents may be immiscible. On the other hand, all components in distillation, gas diffusion or thermal diffusion are usually well distributed between the phases. Sublimation and crystallization may be either way. This factor makes a difference in our calculations.

Temperature also makes a difference. Some operations are carried out under isothermal conditions. For others, temperature gradients are produced incidentally; while still others depend on temperature differences for their operation.

#### Similarities Are Many

Now that we have classified the mass transfer operations according to their differences, let's explore the similarities. This will help us understand them better. The carry-over from one operation to another makes calculations easier.

The mass transfer operations are similar because the basic mechanism, molecular diffusion, is similar.

Here are several points of similarity between the various operations:

Phase equilibrium after a long period of contact.

- Use of equilibrium stages for calculations.
- Rate of transfer determined by deviation from equilibrium concentration.
- Equilibrium at phase interface, with some exceptions.
- Transfer due to molecular diffusion and turbulence.

## Phase Equilibrium Controls Mass Transfer

When two phases are in contact, the compositions of the phases move in the direction of equilibrium. This composition change is brought about by transfer of mass. The rate of mass transfer is proportional to the displacement from equilibrium. When the phases are in equilibrium, no further net mass transfer takes place.

Some equipment is arranged to give a number of phase contacts with practically complete equilibrium at each contact. To design this kind of equipment, we use the phase equilibrium to calculate the number of equilibrium contacts that we need.

In other cases, phase compositions change continuously in the equipment. For these, we calculate the rate of mass transfer from the concentration driving force. This is the difference between the actual phase concentration and the equilibrium concentration.

### Resistances to Mass Transfer

When molecules move from one phase to another, they must go through one phase to the interface, then across the interface. Finally they move from the interface into the bulk of the other phase. Mass transfer within a single phase takes place by a combination of molecular diffusion and turbulence.

We look at the resistance to mass transfer within a phase as though the transfer were taking place through a stagnant film. Resistance to transfer of an active substance is provided by molecules of the inert material. Turbulence helps the mixing process and reduces the resistance.

We usually assume that there is no resistance to mass transfer between phases. This isn't always correct.

In extraction, surface active agents have been found to collect at the interface and interfere with the extraction.

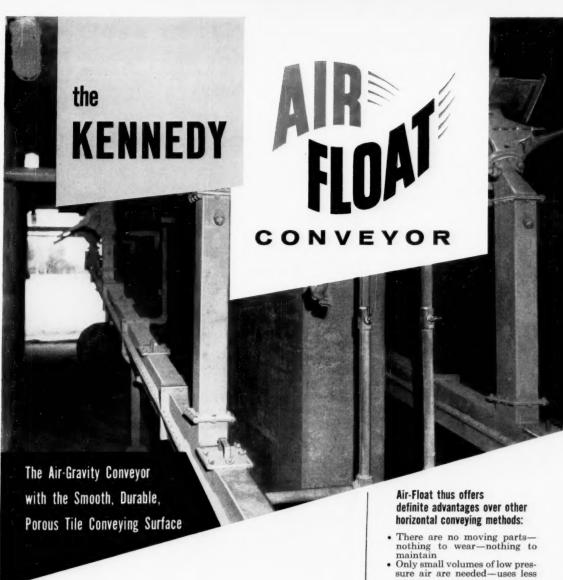
In absorption, substances have been found which appear to inhibit the transfer of solute from gas into the solvent. Other substances clear the interface, thus giving a greatly increased rate of absorption.

In crystallization, there is a kind of interfacial resistance because of the orientation of the molecules in the crystal.

## Coming Soon

In future installments, we'll get down to particulars and show how changes in phase composition apply to the design and operation of equipment for mass transfer.

Next month we'll discuss driving forces in mass transfer. After that, transfer rates; then equilibrium stage calculations.



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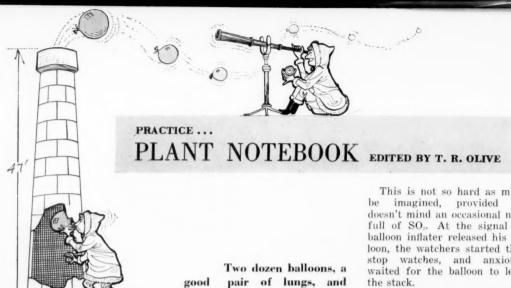
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stop watches solved the prob-50z absorption tower lem of gas velocity in an acid absorber stack.

## **Balloons Pace Gas Velocity**

Lyndon Babcock

Chemical Engineering Dept., University of Washington, Seattle, Wash.

Last summer while I was working for the Ketchikan Pulp Co., in Ketchikan, Alaska, we faced a problem of determining gas velocity in the 47 imes 6-ft. stack of an acid absorption tower. Our attempts at making a pitot tube traverse failed due to the short length of stack ahead of the measuring point.

To overcome this the company was considering building a scaffold somewhere up the 47-ft. stack. At this point a new twist on an old idea occurred to us and

we bought 2 dozen assorted balloons for 26 cents-the result of Alaska inflation.

a couple of watchers with

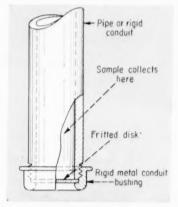
One man we stationed atop the power house, with another on a cliff overlooking the acid plant. The third man hied himself to a 4 × 1-in. sample opening near the base of the stack. Our idea of inserting a blown-up balloon through the sample hole met only with failure so we hit on the scheme of inflating the balloons inside the stack from the outside.

This is not so hard as might doesn't mind an occasional nosefull of SO. At the signal the balloon inflater released his balloon, the watchers started their stop watches, and anxiously waited for the balloon to leave the stack.

Of the 19 balloons which didn't break, one or the other of the observers spotted 10 as they left the stack. The time of ascent was surprisingly constant—so the company abandoned all idea of building the scaffold.

For those who may have the urge to fly balloons on company time, here are a few suggestions.

- · Long, cylinderical balloons work better than spherical ones.
- · Red is the most visible color, blue and yellow the least visible
- The larger the balloon, the easier it is to see.



## Phase Separator Used for Preferential Sampling

B. B. Klima and A. D. Ryon Union Carbide Nuclear Corp., Oak Ridge National Laboratory, Oak Ridge, Tenn.

When working with solvent extractions or other operations in which organic and aqueous phases are intimately mixed, it is often advantageous to be

## NEXT ISSUE: Solvent Extraction Handled by Washing Machine By Stanley Seltzer & R. R. Paxton, Winners of the February Contest

## \*How Readers Can Win

\$50 Prize for a Good Idea-Until further notice the Editors of Chemical Engineering will award \$50 each four weeks to the author of the best short article received during that period and accepted for Plant or Design Notebook.

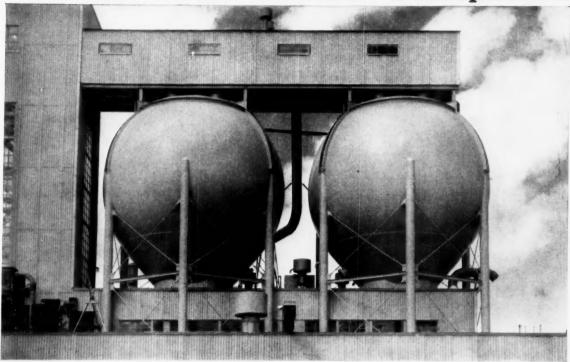
Each period's winner will be announced in the second following issue and published in the third or fourth following issue.

\$100 Annual Prize-At the end of each year the period winners will be rejudged and the year's best awarded an additional \$100 prize.

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Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Design Notebooks, Chemical Engineering, 330 W. 42nd St., New York 36, N. Y.

## The Case of the Airborne Conispheres:



## Why Linde wanted them ... How CB&I designed and built them

In order to keep a ready and free-flowing supply of calcium carbide available for generation into acetylene, the Linde Company specified that these two 500-ton capacity Conispheres\* be installed on the roof of their Montague, Michigan, plant. In order to overcome a specific set of problems it was necessary for CB&I to incorporate special features into their design and construction. Here's how it was done:

Problem: Insure safe, continuous operation.

Solution: (1) Structures were designed to meet a specified emergency condition at an increased stress level, as well as to meet normal service conditions at normal stress levels in all parts not governed by explosion conditions. (2) A series of six safety outlets vent tanks upward. (3) Heavy baffle plates were suspended inside the tanks to control flow of carbide.

**Problem:** Tanks must support superimposed load of gallery and feed belt equipment.

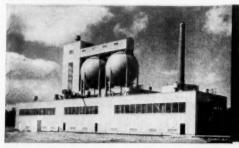
Solution: Special framing distributes load to supporting columns of the tanks.

Problem: Tanks must be mounted on sloping roof.

Solution: Three of the supporting columns are longer than others to compensate for roof plane.

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\*A Conisphere is a Hortonsphere® designed with conical bottom outlet.

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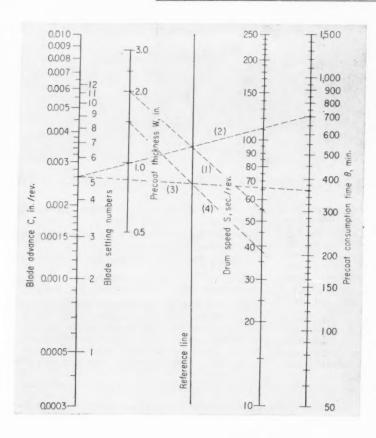
able to sample one of the phases independent of the other. For example, without separating the phases, additional extraction may take place after sampling so that the steady-state condition in the extractor at the time of sampling cannot be determined accurately.

In our experimental work on the Amex and Dapex processes for solvent extraction of uranium from sulfuric acid leach liquors we wanted to sample separately the mixed organic and aqueous phases so as to be able to obtain more precise data from which to evaluate the extraction.

For this purpose we constructed a preferential sampler consisting of a section of pipe with a piece of fritted material held securely to the lower end. When the sampler is immersed in the mixed phases it will preferentially pass whichever phase wets the fritted material. To pass the organic phase the ma-

terial can be fritted Kel-F, Teflon, etc. Fritted metal, glass, etc., can be used to pass the aqueous phase.

This method has certain limitations. The sampling rate depends on the pressure differential across the fritted disk, but too high a differential will entrain some of the other phase. Also, sampling rate for a given differential will vary with porosity and thickness of fritted material.



## **Chart Finds Precoat Filter Cake Time**

Stanley Tolin

Plant Manager, Vico Products Co., Chicago, Ill.

Production people must often estimate the consumption time of the precoat medium used to precoat rotary vacuum filters. This time will vary with alterations in filter settings due to differences in feed slurry, filter aid and wash cycle. We have found the chart above useful in estimating the time of precoat consumption, as well as the length of filter cycle.

The nomograph is based on the equation:  $\theta = WS/60C$ , where  $\theta$ 

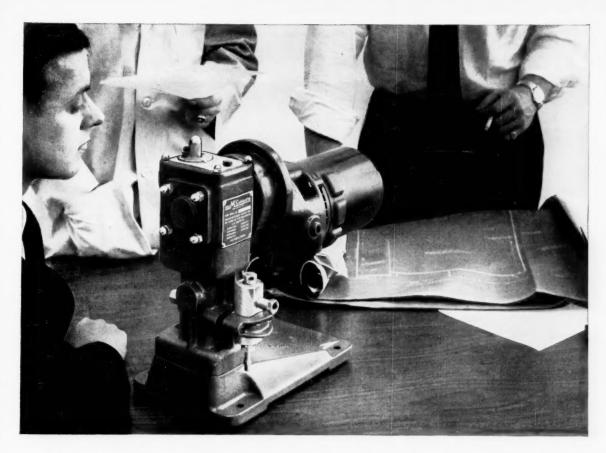
is the precoat consumption time, min.; W is the precoat thickness, in.; S is the drum speed, sec./rev.; and C is the knife advance, in./rev. For convenience the righthand scale of the C axis is calibrated in the common knife blade settings.

Example I—If W is 2 in., S is 55 sec./rev. and C is 0.0026 in./rev., what is the precoat consumption time? Connect 2 on the W scale with 55 on the S scale (Line 1) and extend to the Reference Line. Connect the Reference Point with 0.0026 on the C scale and extend (Line 2) to the  $\theta$  scale at 700 min., or 11.7 hr. The approximate throughput can then be determined by multiplying precoat consumption time by the filtration rate.

The chart can also be used to determine the drum speed or depth of cut needed if the available time is fixed. Sometimes increasing the drum speed or depth of cut will increase the filtration rate without loss of yield, but this, of course, must be checked.

Example 2 — If the precoat thickness W is 1.5 in. and the cut C is 0.0026 in., what drum speed will be needed if the precoat consumption time is to be 360 min.? First, connect 0.0026 on the C scale with 360 on the  $\theta$  scale (Line 3) to determine the Reference Point. Then connect 1.5 on the W scale with the Reference Point and extend (Line 4) to 38 sec./rev. on the S scale.

This means that if the speed of the drum is increased to 38 sec./rev., then the 1.5-in. precoat cake will be depleted in the 360 min. New drum speeds or consumption times can similarly be determined if the depth of cut is altered.



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HOW TO SELECT

## **Best Plastic for Tanks**

A wide variety of plastics is now available for chemical tank construction. Each has advantages and disadvantages. Here is how to pick the best plastic.

W. Reybold, Haveg Industries, Inc., Wilmington, Del.

Plastic tanks should no longer be considered exotic items of equipment.

The engineering of plastics is fully developed to the point where a tank can be designed for a specific chemical service at a particular temperature and pressure. In most cases, cost will be somewhat less than a stainless steel tank, and plastic will last much longer. When not reactive, plastics have no rate of attack, while metals react,

In this rapidly changing picture, the average chemical engineer can get easily confused by the large variety of plastics available for tank construction.

although slowly, even under

ideal conditions.

When should you consider reinforced plastics? When filled plastics? When do you need reinforcing members?

We are going to try answering these questions by examining the comparative corrosive and physical characteristics of plastics for tank construction. And we will discuss some design problems.

► Selecting Material—A first step in material selection hinges on desired chemical corrosion resistance.

In the case of storing dilute sulfuric acid, polyvinylchloride, polyester glass, acid-digested asbestos, filled-phenolic resin, several grades of stainless steel, a type of stoneware, rubber-lined steel and Teflon can be used. There is a wide choice of materials to meet a given condition. This choice quickly becomes limited as the temperature and pressure at which the tank must work is advanced, or as the economic aspects of the

installation become important.

Most plastic materials lose tensile strength very rapidly as temperature rises above the safe limit of their operation. It is essential to know not only what temperature the material will withstand, but also the maximum temperature at which it is going to operate. Sufficient thickness can then be provided to stand the physical load (or ample reinforcing to do the job).

With metals, the use of shorttime strength values in the usual design formulas, with normal safety factors, would be the accepted practice. With the usual plastic materials, such a procedure would not only be bad practice, but might actually lead to an incorrect result. A true plastic would be permanently deformed by any load, no matter how slight. A truly elastic material, on the other hand, would return to the original dimensions.

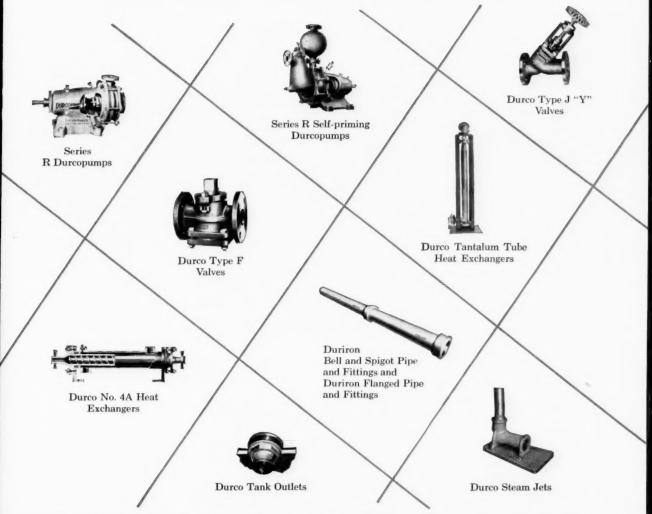
As an example, phenolic and furfuryl-alcohol-resin asbestos compositions behave somewhere between these extremes. The stress-strain diagram is usually a straight line under light loadings, becoming definitely curved as the loading increases toward the point of failure.

Translated in terms of operation, this means the material may be permanently deformed under loading conditions well within the safe limits predicted from short-time ultimate strength figures. This tendency is noticeable at room temperature and becomes marked at the maximum of 265 F. and 300 F. It is similar to the phenomenon of creep in steel at high temper-

Actual data on the allowable loads to prevent this permanent deformation are very limited. Investigations are underway to obtain reliable information for practical use. In practice so far, the condition is met by applying external metal or wood reinforcements, except where loading conditions are well

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the waste treatment plant—Durco products are on the job. Many were original equipment, more are being specified as replacement on tough service jobs.

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within the proportional limit.

Wall thickness in tanks and similar items are, therefore, often determined more by the necessities and convenience of the molding operation than they are by ultimate strengths. For instance, the thinnest plastic wall practical is ½-in. and the maximum is about 2½-in. Wall thicknesses practically always fall within this range.

There are four important plastic groups for tanks: glassreinforced polyesters; glassreinforced furans, phenolics, and epoxies; filled furan and phenolics; and polyvinylchloride.

► Glass-Reinforced Polyester—Glass-reinforced polyester is not one but a whole family of plastic materials. With different reinforcings of fiberglass or synthetic fibers, and with the large number of polyester resins available, there is a wide range of strength, corrosion-resistance and also price for vessels of this material. This enables the manufacturer to tailor the tank to the user's varied needs. The plastic is lightweight and ideal for portable equipment.

This family is resistant to acids and their related salts to operating temperatures up to 212 F., with acceptable peaks to 250 F. However, there are distinct disadvantages which limit its use. It is not recommended wherever chemicals are handled which attack glass, such as hydrofluoric acid and its derivitives. In this case, mats made of appropriate corrosion-resistant material may be added to resist attack.

Polyester is easily field cut by woodworking equipment. Repairs may be made by plant maintenance men without special training. In many cases it has been installed in the field, using old steel or wooden shells for support. The shell may then be cut away or used as an additional brace for the self-supporting polyester.

Commercially produced glassreinforced polyester is now used in tank trucks for transport of corrosive chemicals.

In addition to high strength and the high degree of corrosion resistance possible with reinforced polyester, there is the Where to Use Plastics in Tanks

Phenolic resin. Asbestos reinforced. Nonoxidizing acids; salts; hydrocarbons; chlorinated solvents; 300 F. max.

Phenolic resin. Graphite filled. Hydrofluoric acid and related compounds; 220 F. max.

Furan resin. Asbestos reinforced. Nonoxidizing acids; salts; alkalis; alcohols; esters; ethers; hydrocarbons; 265 F. max.

PVC-pure, rigid, unplasticized.
Acids; oxidizing agents; salts; 150 F.

Phenolic resin cement. Carbon filled. Nonoxidizing acids; salts; solvents; 360 F. max.

Furan resin cement. Carbon filled. Nonoxidizing acids; salts; alkalis; solvents; 340 F. max.

Polyester resin cement. Silica filled. Acids; alkalis; salts; weak alkalis; solvents; 250 F. max.

Polyester resin. Glass fiber reinforced. Acids; hypochlorites; salts; weak alkalis; solvents; 212 F. max.

Epoxy resin. Glass fiber reinforced. Nonoxidizing acids; salts; alkalis; 212 F. max.

distinct weight saving advantage. In a large tank truck, this can amount to several thousand pounds additional carrying capacity while still staying within the axle load limits.

► Other Reinforced Plastics—Glass-reinforced epoxy resins and glass-reinforced furan resins are really much the same as the polyesters, except for improved chemical corrosion-resistant properties. Perhaps the greatest drawback to the epoxies are their cost.

Compared to polyesters, the glass-reinforced furan resins possess a greater, more varied resistance to chemical corrosion. Strength and impact-resistance are comparable to, and fire resistance is substantially improved, over polyesters.

▶ Filled Plastics—A wide variety of highly corrosive plastics can be produced by varying the filling material. However, tensile strength in this group is generally lower than the reinforced plastics. Impact resistance is much lower than the glass-reinforced polyesters. Despite these drawbacks, filled-phenolic and furan resin plastic

vessels are the real workhorses of the chemical industry.

In the larger size vessels or those under pressure, these plastics may require reinforcing.

It is the asbestos-filled phenolics and furans in this group, which offer resistance to extreme temperature overloads. If suitable provision has been made for differential thermal expansion (approximately two times that of steel) in design and mounting of the vessel, very extreme, short duration thermal overloads can be sustained without appreciable damage.

The vessels of this family, like those in the polyesters, are adaptable to easy repair and/or modification in the field. Large or small amounts are readily mixed on the job.

A composition containing furfuryl-alcohol resin and acid-digested asbestos filler has received wide commercial use. It resists corrosion attack by alkalis, acids, salts and many solvents.

Another filled plastic employs epoxy resin combined with graphite as a filler. It is primarily for use with hydrofluoric acid, and related compounds, which react with asbestos.

The commercially manufactured phenol-formaldehyde resin, in composition with aciddigested asbestos fiber, has been employed frequently in plating operations. Advantages of this material are quite definite: It is a nonconductor of electricity, has no tendency to plate out metals on the tank, allows no stray currents to pass, does not contaminate the metal solution in any way, and is not effected by minerals, acids, or organic acids. It is uneffected by thermal shock or sustained temperatures up to 300 F.

Polyvinylchloride (PVC) — Polyvinylchloride, or PVC, exhibits excellent resistance to most acids. It is used as a self-supporting material for use in smaller tanks which do not have to sustain temperature loads exceeding 140 F. PVC is easily fabricated in the plant or modified and repaired in the field. This involves a hot-air welding technique using various shaped PVC rods and finely concentrated hot air streams.





# underwater, underground— this hose loves its salt diet

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flexible enough to follow the contour of the river bottom on which it lies and to handle any shifting due to river currents. Its sturdy cover is unaffected by both river silt and exposure to weathering (where it comes out of the water on either side of the river).

You'll find U.S. Pilot Pipe at work in a wide range of industries, in a wide variety of demanding uses. It's available to you at your "U.S." Distributor, at "U.S." Branch Offices, or write us at Rockefeller Center, New York 20, N. Y. In Canada, Dominion Rubber Co., Ltd.

\*Leslie Salt Co., Newark, Calif.



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Plating tanks, electrolytic tanks, fume ducts and many other lower temperature applications are effectively handled by PVC. However, at temperatures much below zero this material will become extremely brittle. Because it starts to replasticize (soften) above 160 F., PVC is many times more suitable as a supported liner.

All these materials are most often used in stationary equipment. Although they can stand shocks or blows remarkably well, there are limits. Such equipment should not be subjected to abusive shock conditions, as would be encountered, for instance, by dropping a load of steel into a pickling tank. The resistance of these materials to abrasion is good. They are actually used for wear plates in certain wire-pickling processes.

Scratches and gouges need cause no concern in selfsupporting equipment because corrosion resistance exists throughout the entire mass. Nevertheless, they will not resist for long the grinding action of sand particles or the effect of a direct high-velocity jet stream.

► Cylindrical Tanks—As for actual construction, cylindrical tanks are designed for atmospheric pressure, pressure above atmosphere and vacuum.

Cylindrical atmospheric tanks in one seamless piece are made in sizes from a few inches diameter up to 10-ft. diameter and in depths to 15-ft. Still larger tanks can be produced by bolting sections together. They can be equipped with manholes, covers, and other accessories.

There are four types of cylindrical tanks regularly supplied for service at atmospheric pressure: flat bottom, sloping bottom, dished bottom and cone bottom.

▶ Pressure Vessels—One piece cylindrical pressure tanks are made in sizes up to 8-ft. diameter by 15-ft. long. The bodies of the tanks are reinforced with

-Next Issue: Towers-

How do you judge between competent and incompetent plastic equipment design? In our next issue we will discuss important engineering and design factors for plastic towers. Many of these are applicable to all types of plastic equipment.

wood staves and steel hoops. And the heads are protected by steel shells, grouted in position with a special cement.

Larger sizes can be made by bolting sections together. Design pressures range from 5 to 15 psig. But special reinforcing permits pressures as high as 75 psig.

► Vacuum Tanks — The construction of vacuum tanks is a radical departure from the ordinary pressure tank. Since it is a vacuum tank, pressure will tend to crush the tank rather than expand it; this makes it necessary to put ribbing on the inside as well as the usual reinforcement of hoops and staves on the outside.

A gas-tight method of construction is always used. When in a horizontal position, vacuum tanks are supported by cradles, usually constructed of wood, formed to fit the outside contour. 
PRectangular Tanks—Rectangular tanks present entirely different problems from those encountered in the design of cylindrical tanks. Most cylindrical tanks, that need additional support, are boarded with wood hoops and staves. Rectangular tanks are metal ribbed.

The general design of rectangular tanks include wall and bottom thicknesses determined by the length and depth of the tank, (vary from ½-in to 1½-in. depending on size). All standard tanks 12-in. or more in depth are provided with a rim around the top edge, for reinforcement.

The ribs used on the larger tanks are painted with a protective coating.

It's evident that a plastic tank is a complex unit. Design is not any more difficult than a metal tank, provided the physical and chemical properties of plastics are taken into account.



## New Wrought Iron Shows Superior Resistance

Successful development of a wrought iron resistant to many corrosives has been announced by A. M. Byers Co., Pittsburgh, Pa. Called 4-D, it's produced from high-purity iron and iron silicate. Big resistance factor: Evenly distributed iron silicate.

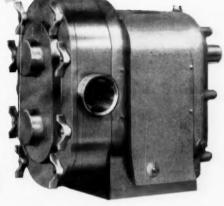
# Now, a giant in capacity...

yet moderate in size

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\*Positive Displacement

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- With the new WAUKESHA 200 D.O.
   Pump you readily meet today's production requirements with capacity-provision for your future expansion.
- For pumping lines that may need protection against sudden high back pressures, or with accurate delivered capacity into filler bowls the new WAUKESHA 200 D.O. can be furnished with a vented cover.
- In fact, all the user-benefits, all the engineering efficiencies, all the new sealing improvements provided by the WAUKESHA PUMP family are yours in the new WAUKESHA 200 D.O.



Send for the Bulletin describing the new WAUKESHA No. 200 D.O. corrosion-resistant Pump. Just a postcard will do.

FOUNDRY COMPANY

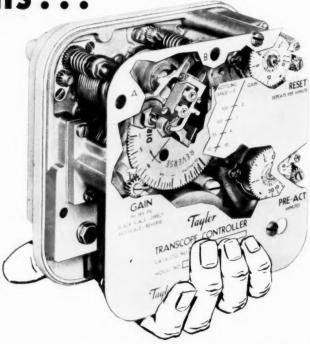
Dept. U-3, WAUKESHA, WISCONSIN

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- Outstanding adaptability
- More accurate response settings

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- 4. Maintenance is simple because the motion-balance



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\*Trade-Mark

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## Chemical Engineering

# People

## MARCH 24, 1958

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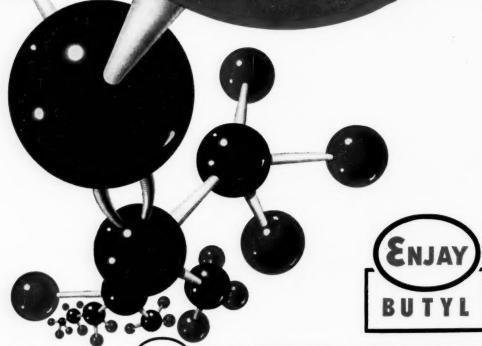
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# the growth of a giant...

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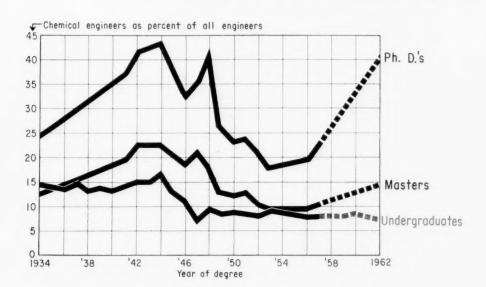
Since the war, Butyl has been applied to many other exciting uses. Its wide variety of outstanding physical, chemical and dielectric properties give it a versatility unmatched by any other rubber, natural or synthetic. Today Butyl makes possible better quality automotive, electrical, industrial and domestic products.

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## Chem. Engineers Continue to Lose Ground

You're invited to read over our shoulder. This open letter to the career guidance committee of AIChE takes a critical look at statistics on engineers.

Dr. Raphael Katzen, Chairman Career Guidance Committee American Institute of Chemical Engineers

#### Dear Ray:

At our last meeting in Chicago, several members of our committee were concerned about the outpouring of statistics—contradictory and confusing—on the engineering manpower situation. They had reached the point in their thinking where their minds were closed to any new statistics, because they were so wary of the figures that they had already been exposed to.

You will recall, of course, that it was my yearend report on the objectives of the national committee that kicked off the question of statistics. In a forthcoming letter, I'd like to discuss the engineering problem created by the conflicting statistics on engineering manpower; but before I do that, I request your permission to spend a few moments on a matter of urgency.

When we met in Chicago, I came with the reassuring news that the U.S. Office of Education had finished its work on 1957 engineering graduations and enrollments, and that the figures were all on the upward swing. This, indeed, was encouraging news. Dr. Armsby, Chief for Engineering Education, U.S. Office of Education, had counted over 31,000 B.S. engineering graduates in June 1957, an 18.6% increase from the year before.

Engineering enrollments had jumped to 78,757 students in the Fall semester of 1957. And this is certainly a pat on the back for all the hard-working career guidance people who have

steered these talented young Americans into engineering colleges.

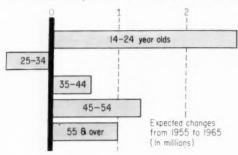
I had hoped to present a complete breakdown of these graduations and enrollments when we met in December, but final figures were not available until yearend. Now I have these final figures and it is with a sense of anxiety that I pass along some quick calculations to you, our committee and to chemical engineers everywhere.

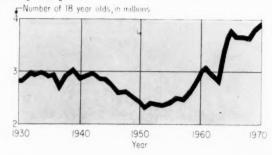
#### We're Falling Behind

Gentlemen, we are running faster and faster; but we're losing the race. Although our engineering colleges poured out 2,796 men with B.S. degrees in chemical engineering this past June (and 22 women), chemical engineers represented only 9.0% of all B.S. engineering graduates.

Of all students enrolled in engineering schools only 7.5% are enrolled in chemical engineering programs. We have but 7.1% of the freshmen, 8.9% of the sophomores, 8.3% of the jun-

## Tomorrow's Gap in the Male Labor Force and in College Eligibles





In 1965 there will be 700,000 fewer men aged 25-34 than today.

In the 1930's 8 million fewer babies were born than in the 1940's.

iors, 8.5% of the seniors; 10.6% of those in their fifth year of a 5-yr. program; 9.1% of those in their fifth year of a 5-yr. cooperative program; 4.8% of the part-time day and special students; and 2.4% of the evening students.

#### Chart Spots the Losses

For your convenience we have reproduced above a chart which we used previously (Chem. Eng., June 1957, p. 355) and to which we have now added projected future graduations. Our only assumption must be that the same ratio of students fail to complete their courses in chemical engineering as in any other branch of engineering.

Without taking the time to dig out the statistics, our intuition tells us that, if anything, chemical engineering students would have a higher casualty rate than students in the other branches of engineering.

So the picture may be even bleaker than we have drawn it.

#### And It May Get Much Worse

Now why should we be concerned at all about this? After all, numerically we are graduating more chemical engineers, even if the percentage figures are down. In 1957 we turned out 2,796 chemical engineers. That's the highest production since the Spring of 1952.

But we very decidedly should be concerned with the percentage decrease. Because the percentage decrease can very easily become a numerical decrease also. In the 1950's and the early 1960's we will be trying to service the needs of the high-birthrate population of the 1940's and 1950's with the low-birthrate labor force of the 1930's.

Consider the impact of the left-hand chart above. In 1965 there will be 700,000 fewer men aged 25-34 than in 1955. Significant reversal of this downturn in labor-force will not be possible until the "war babies" of 1945 and later vintage arrive at college campuses starting in 1963 and pass on through to cap and gowns in 1967 and after.

What do we do in the meantime?

Should we be satisfied with a decreasing share of engineering graduations, although total graduations are increasing? Should we continue to expend time and effort in broad shotgun campaigns to increase the supply of scientists and engineers so vital to our future national security?

Or should we trade in our shotguns for lassos that will corral more talented youngsters into the ranks of chemical engineering?

#### One Dies, One Joins

Members of our profession have differing opinions on the way in which questions such as these should be answered. We have heard expressed in meetings of our own committee attitudes such as these: "We should encourage participation of our members in guidance activities in colleges, high schools and even public schools. We should talk about chemical engineering when we get the chance, but it's also worthwhile to talk about all engineering and science in general. The important thing is to get as many youngsters as possible interested in science and engineering careers, even if they don't become chemical engineers."

"We don't have enough time or people to worry about science in general, or engineering in general, we should spend our time and concentrate our effort on recruiting more students for chemical engineering."

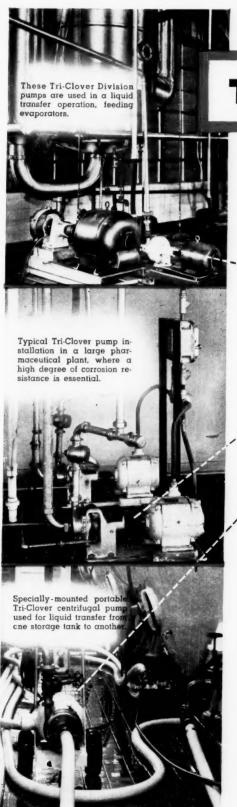
"Who wants more chemical engineers? There are too many of them now. We ought to have a rule in AIChE like the one that seems to exist in the American Medical Assn.: When one chemical engineer dies, then we ought to let a new one in."

#### Some Unfinished Business

So it seems as if we still have some unfinished business on our hands. We are losing our fair share of the harvest; and things will get worse before they get better.

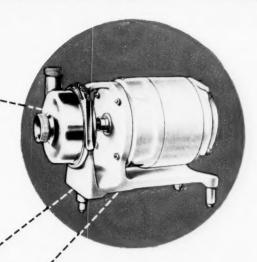
Should we do anything in career guidance to try and stem the tide? Is there really anything we can do? Perhaps, it's all none of our business and we should let nature take its course.

But there is something that



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we ought to do regardless of what our final decision may be. Our committee ought to take a long, hard look at the problem of chemical engineering manpower.

And our first hurdle will be the maze of statistics available on engineering manpower in general and the lack of statistics on chemical engineers in particular

As you know, part of our duties for Chemical Engineering include reporting and interpreting developments in the field of engineering manpower. We have been planning to do a You & Your Job feature on this subject in one of our early issues. Perhaps it will be written in time for our next meeting in Montreal. However, I do think that we ought to take an engineering look (a chemical engineer's look, that is) at the engineering problem of chemical engineering manpower, as soon as possible.

I commend this topic for the agenda of our next committee meeting.

In the meantime, best personal regards.

Cordially,
RAY FREMED
Member-at-Large
Career Guidance Committee

### **EDUCATORS**

#### . . . Meet Industrialists

First "post-Sputnik" collegeindustry meeting sponsored by the American Society for Engineering Education took place last month at Ann Arbor, Mich.

Here are some of the conclusions as reported by McGraw-Hill's Detroit news bureau:

• ASEE reaction to the Eisenhower administration's federal scholarship plan was cautiously negative. As one participant stated, "We hesitate to even discuss forms of government aid because some of us feel that there would be strings attached to any such program. Industry feels that it's cheaper to help support our schools with tax-exempt dollars than to pay taxes to the government for doing it."

· Scholarships seem to be

secondary in importance to the problem of finding teachers to support the whopping 70% increase in enrollment expected in the next 15 years.

· Educators aren't happy with the current crop of high school graduates. We need active education, not passive, at all levels. There should be pain in our education system, just as in the rest of life. These kids should learn to study 'till it hurts in the head. We must have constant competition. There might be some nervous breakdowns, but those can be corrected. We must have a change in the philosophy of the "aver-Our secondary schools now think that there should be no "losers." This is contrary to life as we live it.

## \$70,000 GIVEN

## . . . to Science Writing

A pilot grant of \$70,000 from the Alfred P. Sloan Foundation will finance an advanced science writing program at Columbia University's Graduate School of Journalism.

The grant was made because, "Large scale scientific development depends, in the last analysis, on public understanding. This understanding, in turn, is possible only if scientific news is intelligently and fully reported."

Important objectives of the program are:

• To increase the number of dependable science and technology writers on newspapers, press services, magazines, radio, television and in industry.

• To increase substantially the number of reporters and editors who, though not devoting full time to science, will be able to handle such material interestingly and accurately.

• To provide a means of helping present science writers to broaden their knowledge of subject matter and techniques.

## TIDE TURNS

## . . . at North American

You may remember the extensive publicity given to the cancellation of the "Navaho" missile contracts (North American Aviation, Rocketdyne Div.) last summer; and to the "1,000 engineers and technicians walking the streets of Downey, Calif."

It's a pleasure to report that the tide has now reversed. In a recent issue of North American Aviation's own employee newspaper the following announcement appears:

"Engineering Jobs at Rocketdyne—Rocketdyne needs research engineers with experience in combustion devices development, engine systems or chemical engineering."

We hope that this announcement signals a turning point in recent soft market conditions for research engineers.

#### KAISER CUTS

## . . . Engineering Staff

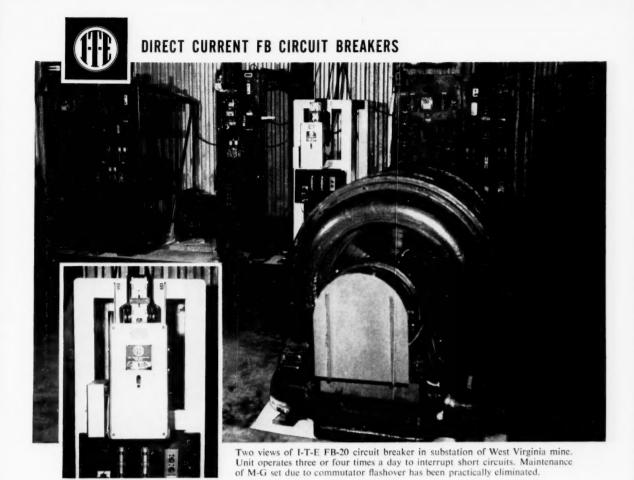
Because of recent setbacks in aluminum sales, Kaiser Aluminum Co. is laying off engineers and technical personnel at two of its Louisiana plants. First layoff involved 50 professional people.

The layoff was especially surprising to several young 1957 graduates in chemical engineering. They had started work at \$465/month; by January they had been upped to \$535/month; and their supervisors had told them that they could expect to be earning \$600/month by June of this year.

The unexpected "pink slips" were disillusioning, to say the least.

## Next Issue: What's Wrong With Engineering Education

To achieve a new level of excellence, Dr. James R. Killian, Jr. gave a five-point program for improving engineering education to the recent "summit" conference in New Haven. We excerpt this speech next issue and add to it the thoughts of Cornell's Dusty Rhodes on what's wrong with chemical engineering education today.



# Reduce maintenance on 600 volt M-G sets by preventing commutator flashover damage

A large mine in West Virginia uses a 2000 amp I-T-E current-limiting type FB-20 circuit breaker to protect a 600 v motor-generator set in its substation. This substation supplies direct current to haulage equipment and mining machinery underground. Short circuits occur frequently due to roof falls, cable cuts and similar exigencies—in fact the FB-20 circuit breaker interrupts as many as four times a day; and the M-G set has never suffered any damage. In contrast, the protective device used before permitted some commutator flashover, and costly maintenance work resulted.

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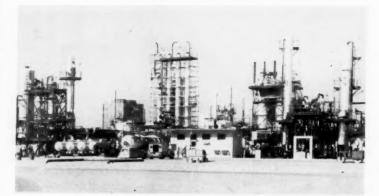


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HIGHER OXO ALCOHOLS. By Lewis F. Hatch. John Wiley & Sons, New York. 120 pages. \$4.50.

In less than two years, the productive capacity for higher oxo alcohols has doubled—to 150 million lb./yr.

This handy little book fills a definite need to update available information on this key process and its products, to present it conveniently and tersely between covers.

One of the most valuable assets of this slight volume is its exhaustive list of references—409 in all—to journals and patent literature. Most of these range from 1950 to 1956. Thus, it smartly updates such standard references as Kirk and Othmer's "Encyclopedia of Chemical Technology" and Groggins's "Unit Processes in Organic Synthesis."

▶ Beyond the Process—Twothirds of the book is devoted to reactions and applications of oxo products, with special emphasis on the higher alcohols.

While chapter one is concerned with the oxo process, chapter two discusses oxidation of aldehydes to acids, organic and inorganic esters of oxo alcohols, and ethers, acetals and other products and their properties.

Chapter three's 21 pages list

uses of oxo derivatives as plasticizers, discussing properties and performance in resins and plastisols.

Following a brief treatment of agricultural applications, a final chapter discusses use of higher oxo alcohols as detergents (mainly nonionic) and wetting agents.

► Abridged Engineering -Though not as thorough as other texts in treating applied engineering, the book does give a short, up-to-date review (with tables and drawings) of fundamental considerations: Influence of reaction variables on products from different feedstocks, effect of temperature and olefin structure on product distribution and effect of structure on type of reaction (oxonation, hydrogenation). There are nearly five pages devoted to catalytic action.

Engineers involved in the field will gladly make room (about one-half inch) on their bookshelves for this volume.—

#### BRIEFLY NOTED

ADDENDUM TO API STANDARD 620 (RECOMMENDED RULES FOR THE DESIGN AND CONSTRUCTION OF LARGE WELDED LOW-PRESSURE STORAGE TANKS, American Petroleum Institute, Publications Dept., 50 W. 50 St., New York 20, N. Y. 25¢. Covers errata, changes and additions to Standard 620, 1st ed., published in February, 1956.

AMERICAN STANDARD LETTER SYMBOLS FOR HEAT AND THERMODYNAMICS. 14 pp. American Society of Mechanical Engineers, Order Dept., 29 W. 39 St., New York 18, N. Y. \$1.50. Compiles complete list of letter symbols used in heat and thermodynamics calculations.

BOOK OF ASTM STANDARDS, 1957 SUPPLEMENTS. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. \$4 per part; \$28 per set. Parts are: Ferrous Metals (520 pp.); Nonferrous Metals (380 pp.); Cement, Concrete, Ceramics, Thermal Insulation, Road Materials, Waterproofing, Soils (360 pp.); Paint, Naval Stores, Wood, Cellulose, Wax Polishes, Sandwich and Building Construction, Fire Tests (218 pp.); Fuels, Petroleum, Aromatic Hydrocarbons, Engine Antifreezes (340 pp.); Rubber, Plastics, Electrical Insulation (423 pp.); Textiles, Soap, Water, Paper, Adhesives, Containers.

Corrosion and its Prevention. Air-Conditioning and Refrigeration Institute, 1346 Connecticut Avenue, N. W., Washington 6, D. C. 75\(\delta\). Consists of general discussion of corrosion as it afects air-conditioning and refrigeration industry.

Development of Thermally Sta-Ble Polymeric Materials. 67 pp. By C. P. Haber, U. S. Naval Ordnance Laboratory for Wright Air Development Center. Order PB 131253 from Office of Techical Services, U. S. Dept. of Commerce, Washington 25, D. C. \$1.75. Reports work on syntheses of polymeric materials with extreme chemical and thermal stability.

### MORE NEW BOOKS

SURFACE ACTIVE AGENTS AND DE-TERGENTS. Vol. 2. By A. M. Schwartz, J. W. Perry and Julian Berch. Interscience. \$17.50.

Engineering Materials Hand-Book. Edited by Charles L. Mantell. McGraw-Hill. \$21.50.

NUCLEAR RADIATION IN FOOD AND AGRICULTURE. By W. Ralph Singleton. Van Nostrand. \$7.50.

PROCESS ENGINEERING IN THE FOOD INDUSTRIES. By R. J. Clarke. Philosophical Library. \$10.



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PEOPLE ...

## MEET YOUR AUTHORS

M. A. GIBBONS



J. B. Charlton

PLANT OPERATIONS ARE EASIER TO VISUALIZE WHEN YOU USE A YIELD AND CAPACITY CHART. PAGE 142.

Right now, J. B. Charlton is supervising engineer of the economic evaluation group in the planning and process department of Chemstrand's engineering division, located in Pensacola, Fla.

He located in the Pensacola post in January 1955, where work dealt primarily with the expansion of Chemstrand's nylon plant there. Before that time, Charlton worked as a member of the nylon technical information team of the firm's research and development department. For that post, he was stationed in Wilmington for work with DuPont.

Charlton started his career with Chemstrand, in October 1951, as a design engineer in the general engineer department. Work, there, involved the design and startup of the Decatur, Ala., Acrilan plant.

Before joining Chemstrand, Jack worked in all phases of natural gas plant operations, for the Arkansas Fuel Oil Co. He began as a junior engineer on training assignments and later served as engineer at the Panola gasoline plant in Carthage, Tex.

Jack was born and educated in Alabama. His home town is Autaugaville and he earned his B. S. in chemical engineering, in Auburn, at Alabama Polytechnical Institute, in 1949. Professional memberships include the AIChE and the American Association of Cost Engineers.

Hobbies include bowling, golf, fishing and yardwork(?). (We believe that the latter punctuation, contributed by our author, is essential to editorial accuracy.)



James O. Osburn

CE REFRESHER. PAGE 145.

Each of us yearns for what he has not.

In Iowa, where there are no mountains, it's logical that there should be a mountain-climbing club called the Iowa Mountaineers. Since the mountains won't come to the mountaineers, it figures that they must perforce go to the mountains.

Jim Osburn, one of our most diligent Refresher authors, is one of the most active members of the Iowa Mountaineers.

Just past 38, Osburn is associate professor of chemical engineering at the State University of Iowa. He joined the University faculty in 1946, right after his discharge from the U.S. Navy.

Jim earned three chemical engineering degrees from the University of Michigan: a B.S. in 1939; an M. S. in 1940; and a doctorate in 1944. While doing graduate work, he also was working as an engineer with the Werner G. Smith Co., division of Archer-Daniels-Midland.



#### Frances Arne

REPORT: MANUFACTURED GAS. PAGE 121.

When Fran Arne started out on her manufactured gas story, her assignment was to turn out a news story for our "Processes & Technology" department. As far as we knew, at the time, there were two or three big developments to delve into and we thought the story might run a few columns longer than the usual P & T feature.

But, as Fran got her research underway, she realized that there was far more to the subject than we'd thought. Like Topsy, the story "just grow'd and grow'd" till, finally, Fran turned up some eleven developments well worth talking about. It was no cinch trying to squeeze that much material into a couple of pages.

So, one day, Fran carted her "news story" over to Cecil Chilton's desk and hinted that he do what he would with it.

A bit nonplussed, Cecil looked the story over and, next day, Fran was told that she had unintentionally authored a report.

Officially, Fran writes for Chemical Engineering as an assistant editor. On top of her contributions to "Processes & Technology," she handles the "Chemical Products" department. Fran joined Chemical Engineering in April 1947. She began a two-year stint in May 1953 with Harry W. Smith, Inc., publicity firm, as a technical editor. Then, in the summer of 1955, Fran returned to the CE staff as an assistant editor.

Fran's untiring nose for news reflects an irrepressible enthusiasm—which shows up in almost everything she does.

A native New Yorker, she loves the City, knows where to find the best French food, and is

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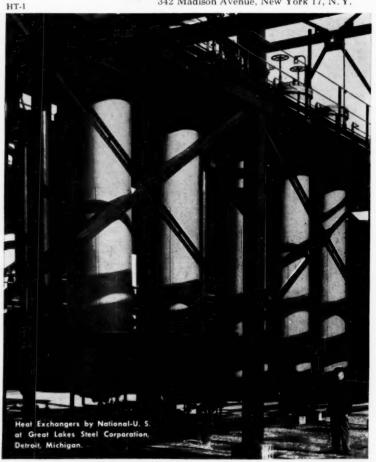


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AUTHORS . . .

an avid theater-goer. After her vacation in Europe last year, she added Italy to her list of special interests and she's now rapidly devouring everything ever written on the Italian Renaissance.

Though she likes swimming and cycling, Fran enjoys the outof-doors most by taking long walks. She thinks nothing of leaving the McGraw-Hill Bldg. after work and "strolling" all the way home—a distance of 50

Fran's other avid interest is reading. And, along with it, she has led one of the local sessions of the Great Book Foundations.

Educational background centered around chemistry: She took an accelerated course at Pembroke College, Brown University, and earned her degree after three years.



R. C. Rohrdanz

DESIGN FOR LOW CON-STRUCTION COSTS. PAGE 133.

Nebraska-born R. C. Rohrdanz has been associated with the design, operation and construction of petroleum and chemical plants for the past 25 years. And, since 1944, he has been specifically occupied with the management of construction projects.

At Tellepsen Petro-Chem Constructors, Houston, Tex., where he works, he is officially labeled manager of construction.

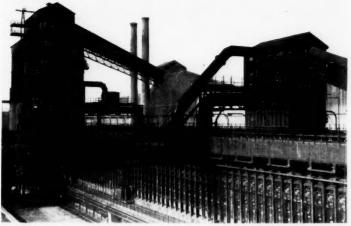
Author Rohrdanz earned his B. S. in chemical engineering, in 1932, from Kansas State.

Rohrdanz is a registered professional engineer in the State of Texas, where he now makes his home.

PEOPLE ...

## LETTERS: PRO & CON

C. H. CHILTON



COKE, IRON, STEEL: "Salvation rests on the chemical engineers."

## Pro: Ch. E.'s in Steel

I was much amused by Sid Kirkpatrick's statement at the Chemical Engineering Achievement Award dinner that you are doing your best to put the "Met" back in "Chem & Met"! Time passes so rapidly that there are probably a considerable number of chemical engineers now extant who do not remember the days of "Chem & Met."

On the other hand, there are a lot of us who feel that the real

salvation of process development in the steel industry rests soundly on the backs of the relatively few chemical engineers who have yet found their way into this field.

H. S. TURNER Jones & Laughlin Steel Corp. Pittsburgh, Pa.

► We reviewed the growing influence of chemical engineering technology in the steel industry as one of the year's Top Ten Technical Trends in our January 13 issue (p. 139).—ED.

#### **Pro: Increased Margins**

Sir:

I have been following with interest the various letters in Pro & Con regarding removal of various articles from the magazine for filing.

You have certainly come a long way in facilitating this operation. Most articles do start on an odd-numbered page and end on an even-numbered page so that they can be separated and filed conveniently.

If at all possible to increase the inside margin on editorial articles, it would facilitate re-

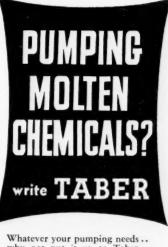
moval of articles by trimming with a razor blade without need for breaking the binding by removal of staples.

SYDNEY KALVER First Machinery Corp. Brooklyn, N. Y.

Sir:

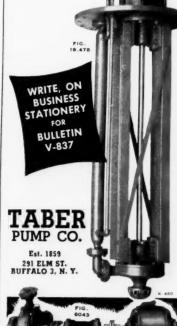
It is very disappointing that you have taken the retrograde step of publishing Chemical En-

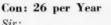
Presumably the change has



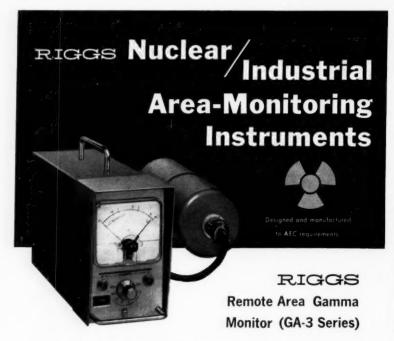
why not put it up to Taber.. long experienced pump specia-lists. Vertical pump illustrated, 19,478, for pumping molten chemi-

cals. Horizontal pump, 6043, handles black liquor, caustic, etc., in evaporator service; or transfers fluids under vacuum.





gineering 26 times per year.



A completely self-contained, independent system with pressurized logarithmic response ionization chamber. Model GA-3B has Mercury battery supply for 4 months continuous operation. Model GA-3BA same as GA-3B but with AC power supply failsafe to DC. Model GA-3A available in AC power supply only.

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The RIGGS four-gang rack unit may be any combination of the above GA-3 series remote area monitoring instruments. A separate power supply is not required. This eliminates the possibility of complete shutdown in event of power supply failure or during maintenance to the monitoring instruments.

The RIGGS system permits service to each individual unit, when necessary, without affecting continuous monitoring by the others.

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Energy Dependence Flat to within  $\pm\,10\%$  from 80 KV to 1.2 Mev.

Alarm Control System
Meter relays DC manual (optional).
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10 mv operated directly from output of unit.

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Log-linear pressurized ionization chamber portable survey meter. Fast response time 0 to 1 mr/hr linear and 2 to 3 decade ranges from 1 to 1,000 mr/hr, .1 to 100 R/hr. Mercury battery powered—300 hr. continuous operation, one year intermittent. Allows fast lab monitoring of low level Gamma-Beta radiation with the linear range and incorporates two higher log ranges for general survey work. Energy dependence—flat to within  $\pm 10\%$  from 80 KV to 1.2 Mev.

Write for free illustrated technical literature and price lists.

Patents Pending.



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PRO & CON . . .

been encouraged by a need for more revenue from more advertising. For the normal user it just means more bulk with little increase in value. In addition the psychological effect of having yet more regular journals to examine is serious.

C. R. BLACK

Aero Research Ltd. Duxford, England

▶ We're glad to get Dr. Black's letter commenting on our new publishing frequency—the only one we have received to date which criticizes our biweekly schedule. Let's analyze his points one at a time:

In the sense that retrogression is reversion to an earlier state or condition, Dr. Black is certainly correct. In the 55-year history of our magazine, we have published semimonthly for four years (1915-19) and weekly for five years (1919-24).

In a dynamic economy such as ours in the U.S., no business stays small by choice. We're convinced that increased frequency of publication is the best way to break away from the monthly "plateau." Naturally, the result is slightly increased "bulk"—958 total pages in the first two months this year (four issues) vs. 908 pages in the same period last year (two issues), a 5.5% increase. This is a fair comparison; our 25th and 26th issues will make up for dropping the Inventory (13th) issue under the former schedule.

What about editorial value to reader? In the first two months this year, we published 364 pages of editorial (non-advertising) matter, compared with 259 pages last year—an increase of 40%. We have budgeted a continuation of this higher editorial-to-advertising ratio throughout the year.

You get another important benefit from our new schedule—greater timeliness. We have shortened our lead time (elapsed time from copy deadline to mailing date) by three weeks. And with an issue coming out every two weeks, you may actually see news stories and engineering articles as much as five weeks earlier than you would under the former schedule

What about psychological effect? Experience so far indicates a definite beneficial effect. Slimmer—and more timely—issues encourage, rather than discourage, immediate reading. And by keeping you up to date in all areas of chemical engineering development and practice, we aim to save you considerable time in your over-all reading budget.—Ed.

## PEOPLE...

## NAMES IN THE NEWS

M. A. GIBBONS



Donald O. Swan

Heading Esso Standard Oil Co.'s newly formed petroleum specialties department is Donald O. Swan. Swan will be responsible for the coordination of all phases of activity dealing with the company's petroleum specialty products—aviation gasoline, jet fuel, liquefied petroleum gas, lube oils, wax, grease, solvents, asphalt, white oils.

Since his graduation as a chemical engineer from the University of Minnesota in 1939, Swan has been associated with Esso. Prior to assuming his new post, he had served as assistant general manager of the company's manufacturing department.

Before that he was assistant general manager of the Baton Rouge, La., refinery, general foreman of catalytic cracking, head of petroleum products operations, head of the refinery's technical division.

C. T. Jones has been promoted to technical specialist in technical service division at Humble Oil & Refining Co.'s Baytown, Tex., refinery. He is specializing in economic analyses of refinery operations.

Carl A. Ruscetta, Jr., has become a member of the industrial design department of Monsanto Chemical Co.'s research and engineering division at Dayton, Ohio, after serving with General Electric Co., Schenectady, N. Y. Reid A. Feather has become a member of the technical services department of the company's organic chemicals division at Nitro, W. Va., after serving as process engineer with Ohio-Apex Division of Food Machinery and Chemical Corp., Nitro.

John R. Brady, Jr., senior technical salesman of Shell Chemical Corp.'s Torrance, Calif., synthetic rubber sales division, has been named district manager, St. Louis.



Frank O. Agel

Nitrogen Division, Allied Chemical & Dye Corp., has announced the appointment of Frank O. Agel as vice president in charge of development.

Agel has been director of development since 1954, supervising the Division's research and engineering program. He has been located at the Division's development center in Hopewell, Va., and will continue in that location.

With Allied Chemical since 1927, Agel has been principal chemical engineer, assistant to the director of development and director of organic development.

Roger C. Corwin has joined the commercial development staff of Richardson Co., Melrose Park, Ill. He is responsible for market research and new

# A package for pollution control

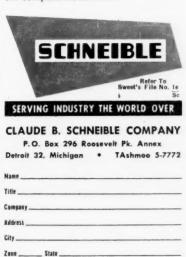
Here is a compact package that will meet your requirements and code requirements for air pollution control and will reclaim valuable by-products in processing.

So simple and so efficient are Schneible Multi-Wash Collectors and slurry tanks, that they continuously earn money for chemical processors.



For product purity control, Multi-Wash units are fast becoming necessary process equipment.

Get details on this package for profitable pollution control. Write or wire for complete information.



NAMES . . .



An important advancement in liquid level observation for plants with dangerous explosive or inflammable conditions.

> Safety design seals against escaping gases.

Measuring mechanism in stainless steel chamber.

Scale mounted outside chamber; magnetically actuated through chamber wall.

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Job designed, correlating pressure, temperature, and specific gravity.

For pressures up to 2500 lbs. @ 600° F.

Can also be used for interface indication.

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product development of resins, plastics and chemicals. Donald A. Sayles, another recent addition to Richardson's commercial development staff, is responsible for technical service and market research activities in support of the company's new plastic laminate development programs.



Sydney Steele

Sydney Steele, who has been acting director of Atlas Powder Co.'s public relations department since last September, has been named director of the department.

Steele joined Atlas in 1950 as manager of market research in what was formerly known as the research and development department. He became director of the planning staff in 1952. and in 1956, was appointed industrial assistant to the senior vice president in charge of Atlas' chemicals division.

Before joining Atlas, Steele served for one year as sales promotion manager of Fischer & Porter Co.; for 14 years with Du Pont at Niagara Falls, N. Y., and in Wilmington in engineering, production, development and sales work; for two years as research engineer with Imperial Chemical Industries in England.

James A. Wold, general manager of Borden Chemical Co.'s consumer products depart-ment, has been given additional duties as general manager of the company's resinite department. From his N. Y. office, he will supervise the company's extrusion facilities in Santa Barbara, Calif., and North Andover, Mass.

Edgar I. Crowley has joined the research and development department of Pittsburgh Coke & Chemical Co. He is a senior chemical engineer in the department's engineering development section.

James H. Moore has been named general manager of NRC Equipment Corp., subsidiary of National Research Corp. He will be responsible for development, production and sales of one of the country's largest lines of high vacuum equipment manufactured at the NRC Equipment plant in Newton, Mass.

W. Roberts Wood has been named president of National Cylinder Gas Co.'s newly formed Girdler Construction Division, activities of which include engineering design and construction of processing plants for petroleum, chemical and other industries. Walter H. Girdler Jr. has been named president of National Cylinder Gas Co.'s newly formed chemical products division.

Ralph N. Thompson has been named director of Hagan Chemicals & Controls' central research and development department. Charles T. Roland, senior engineer in the chemical product development department, will serve under Thompson as assistant manager in charge of chemical product development.

Jack E. Zimmerman, group leader in development for Diamond Alkali Co.'s plastics division since 1953, is now assistant manager of research and development. Joseph V. Hartman, Jr., technical service representative for the division, becomes group leader of the applications section of the plastics research and development laboratory. Nathan M. Blackman has been named group leader in charge of the laboratory's pilot plant section, succeeding Zimmerman.



Ray Loesby

Ray Loesby has been appointed as Alco Product's exclusive agent in the Northwest for Alcotwin finned-tube heat exchangers and immersion, tank suction and line pressure heaters.

A chemical engineering graduate from the University of Colorado, Loesby has been active as a sales representative in the Northwest for seven years. He is experienced in process plant design and operation, product research and development, sales research.

Loesby, who owns the Unit Process Co. in Kirkland, Wash., also represents Keystone Valve Corp., Mission Manufacturing Co., Philadelphia Pump and Machinery Co., Atlas Mineral Products Co.

Norman D. Koch has been promoted to senior design engineer at Union Oil Co. of California's research center, Brea, Calif.

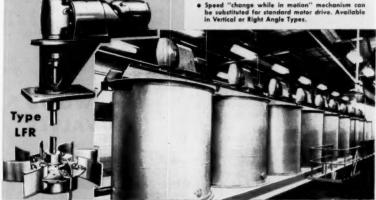
Frank H. Stone, manager of the natural gas and gasoline department of La Gloria Oil and Gas Co., has been named a vice president of the company.

John L. Olsen has been named assistant director and J. Harold Perrine, administrative manager of Sun Oil Co.'s research, patent and engineering departments.

Andrew Tauk has been appointed to the position of chemical engineer at Schwarz Laboratories, Mount Vernon, N. Y.

William Leistner, founder and president of Argus Chemical

## The Answer to Simplified MIXER DRIVES FRAME MOTOR COU. "International" TYPE LWR Right angle Drive with MODULINE\* PACKAGE MOTOR LOW SPEED CAGE WITH CHANGE GEAR, AND SPIRAL REDUCER DRIVE BEVEL GEAR CAGE IN SEP-ARATE PACKAGE UNITS FOR 1 to 30 HP EASY REMOVAL WITH WRENCH COMPLETE INTERCHANGEABILITY NEW PACKAGE MOTOR REDUCER DRIVE—Ratio changes are made in the High Speed Gear set, ahead of the low speed set, both of which are assembled into a rigid, close grained, cast iron cage. This subassembly is a complete unit, with gears and hearings, providing easy removal, accessability and interchangeability. British subassembly is a complete unit, with gears and hearings, providing easy removal, accessability and interchangeability. British subassembly is a complete unit, with gears as save that change gears and pinions will not loosen in service ... NO SPECIAL TOOLS—No machining operations, special tools are necessary to modify the unit to suit a new application, or install removal parts ... Users benefit thru Standardized parts. Only one set of fixed ratio low speed gears are used. The small and economical high speed gear sets are interchangeable and a low value stack will support many gear units in a plant. Fast service from factory and warehouses is another important advantage. advantage. IN VERTICAL AND RIGHT ANGLE TYPES—MODULINE PACKAGE REDUCERS and integral Gearmotors provide a brand NEW, economical and practical answer to most of the problems of Mixer Drive-Head operations. \*Moduline Pkg. Mater Reducer Drives Mid for International by Westinghouse. Complete details are available on request. International - Type LFR - SLOW SPEED · Uses any standard motor, Low Head room. Wide bearing spans increase shaft rigidity. Mechanical efficiency 96 to 98 1/2 1/4. Quiet in operation. AGMA ratings. • 100% starting and momentary overloads. Speed ranges 1 to 350 RPM. Interchangeable speeds. All steel gear housing—unbreakable. · Closed or open vessel operation. @ 1 to 100 H.P. Standard or variable drive motors Speed "change while in motion" mechanism can be substituted for standard motor drive. Available in Vertical or Right Angle Types.



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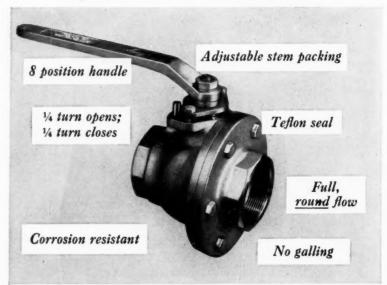
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for the chemical industry



Here's why it will fit your needs—Rockwood's new "316" Stainless Steel Ball Valve offers you all the features above — plus easier operation, low pressure sealing and elimination of entrapment of fluid. It's loaded with features and when it's loaded with chemicals it will deliver a full, round flow every time! It's available with remote air-operation in wanted sizes %" to 2".

#### We also have -

New Rockwood Steam Valve to handle steam up to 125 lbs. P.S.I. and 350°F, with ease. It's leakproof, stays tight. Opens or closes quickly — only ½ turn needed.

Rockwood Regular Forged Valves with screwed ends in all pipe sizes from \%" to 2\\frac{1}{2}" and in cast steel 3" and 4" with flanged ends, recommended for 300 P.S.I. Handle design allows valve to be installed in any

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NAMES . . .

Corp., Brooklyn, N. Y., has been elected president of SA Argus Chemical NV. This European company has just been formed by Argus and Union Chimique Belge of Brussels to produce and sell Argus vinyl stabilizers and plasticizers in Europe.



Charles H. Stockman

Charles H. Stockman has been named manager, research operating at B. F. Goodrich Co.'s research center, Brecksville, Ohio.

A graduate from Purdue University, Stockman joined the research center staff in 1950 as a chemical engineer. He was on loan to the Atomic Energy Commission and served at Argonne National Laboratories from 1953 to 1954.

Theodore E. Casselman, Jr., has been named an assistant engineering manager of Stone & Webster Engineering Corp. Other appointments include Norman L. Foskett, chief engineer of the chemicals division, and Stanley B. Zdonik, chief process engineer.

Gary R. Bahr recently joined the product research department of the foods division of Procter & Gamble.

Frank M. Isola has been appointed general manager of the Pabco Floor Covering Division of Fibreboard Paper Products Corp. He succeeds E. W. Fish, now vice president-merchandising.

J. A. Reid, who has been director of research for Phillips Petroleum Co. at Bartlesville, Okla., is now executive vice president and general manager of Astrodyne, Inc., new company formed by Phillips and North American Aviation to specialize in solid propellant rocket engines.

W. B. Reynolds has been named director of research for Phillips Petroleum Co., succeeding J. A. Reid,

Richard C. Burck, supervisor of product development for Mobay since 1955, has been named manager of product development for the company.

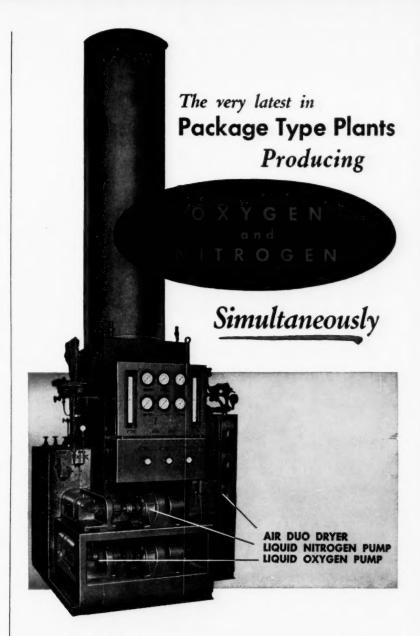
James C. Hance has been named manager, market research, of Jefferson Chemical Co.'s commercial development division. Hance was formerly with American Cyanamid Co.'s market research department.

Dean Daniels has become Western District sales manager for the silicone products department, General Electric Co., with offices in Downey, Calif. Daniels succeeds Robert T. Dailey who has become manager-rubber market development for the department.

Howard G. Egginson has been appointed district manager in New England for Graver Water Conditioning Co., Division of Union Tank Car Co. He will handle Graver's complete line of industrial and municipal water treatment and special applications equipment throughout New England.

Benjamin Friedland has been named to the newly created position of assistant general manager of the Ozalid Division General Aniline & Film Corp. He will be responsible for all operations at new plants; also for engineering traffic and industrial engineering for the entire Division.

John R. Lawrence has been named polyester coordinator for Glidden Co. He will be in charge of development and sale of Glidden polyester products; and will also dis-



With the introduction of our latest, improved design Package Type Generating Plants, production of high purity Oxygen and Nitrogen simultaneously increases production 60% over the production of Oxygen alone, plus a corresponding reduction in the cost of manufacture. Due to its compact design, a minimum of floor space is required and streamlined panel assembly insures instant visibility of all control gauges. Stock sizes from 1500 to 10,000 cu. ft. per hour. Larger and smaller sizes available. 99.99% Argon available on large size plants.

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Patented standpipe around propeller shaft assures positive agitation and circulation 3'x 3' to 20'x 20'

assures positive agricultant and circulation.

Patented wearing plate prevents sand-up on shut-down. Heavy duty as well as acid-proof construction is available in both open-type, air lift and Super Agitator models. lease write for Bulletin No. A2-B4.

DENVER Steel-Head BALL MILL



A Denver Steel-Head Ball Mill will suit your particular need. Five types of discharge trun-3'x 2' nions. All-steel construction. Low initial cost due to quantity production. Quick delivery. Laboratory and pilot plant mills also avail-8'x 20 able. Please write for Bulletin No. B2-B13.

DENVER Automatic SAMPLERS



Heavy duty units, extra rigid track and ballbearing wheels assure positive travel and 16" to 60" timing of sample cutter. Available in stain-Cutter less steel for acid and carrosive service. Wet Travel and dry cutters. Central Control Panel for multiple samplers. Bulletin. No. 51-B4.

DENVER Forced-Feed JAW CRUSHER



Cast Steel Frame, manganese jaw and cheek plates. Large diameter shafts reduce shaft deflection and thus increase life of heavy-21/4"x 31/2" duty, oversize roller bearings in bumper. Setting easily controlled. Please write for Bulletin No. C12-B12. 36"x 48"

DENVER Wet Reagent FEEDER



Accurately maters minute quantities of liquid from 0 cc to 2000 cc per minute. Float valve in tank permits connection of feeder to bulk storage device. Handwheel adjustment to control amount of liquid is simple and accurate. Used in multiples for higher capacities. Please write for Bulletin No. F6-B9. 0 00 10 2000 cc

DENVER Disc FILTER



1 Disc, 2' 12 Disc, 9'

Special, patented design of segments in Denver Disc Filters use both gravity and vacuum to give a drier filter cake. Drainage is complete and positive, with no blow-back. Simple, low-cost, dependable construction. Quick delivery Also Drum and Pan Fillers. Please write for Bulletin No. FG-81.

DENVER "Sub-A" FLOTATION



Flotation is the selective separation of particles from each other in a liquid pulp by means of air bubbles. More large plants are installing Denver "Sub-A's" for their entire flotation job, because they give maximum recovery at a low cost per ton. Dependable, low-cost, simplified continuous operation Please write for Bulletin No. F10-B81.

DENVER Wilfley Concentration TABLES



A mechanically operated, longitudinally reciprocating table consisting of a deck hav-ing a plane surface partly riffled and a tilt-5 to 150 ing device. It separates materials into bands and handles the coarsest sands with excel-T/24 Hrs. lent results. Ideal for separation of groups of particles having a similar range of spe-cific gravities. Write for Bulletin No. 71-83.

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Batch Continuous

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Batch and continuous test models of Crushers, Screens, Ball Mills, Pulverizers, Rad Mills, Classifiers, Agiiators and Mixers, Pulp Distributors, Feeders, Flotation Machines, Pumps, Thickeners, Filters, Dryers, Tebles, Samplers. Results obtained on Denver Laboratory Equipment can be duplicated by commercial ma-chines. Please write for Bulletin No. LG3-B10.

DENVER Standard DRYFRS



Available in several types: Direct Heat, In-2'x 15' direct Heat, and Steam Tube. Let DECO Ente 5'x 40' gineers solve your drying problem. No dryer problem too small or too large. Please write for Bulletin No. D4-B2.

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See Our New Catalog Starting on Page 647 CEC

NAMES . . .

seminate information to the sales force, work with representatives on key accounts, organize technical service programs.

- T. William Mather has joined the sales staff of Emulsol Chemical Corp., and will make his headquarters in the company's new Akron, Ohio, sales office.
- James D. Bushnell has been appointed head of the fuels and treating section in Esso Research and Engineering Co.'s planning engineering division.
- Godfrey Moll has been promoted to assistant manufacturing chemist at Ciba Pharmaceutical Products. Since joining Ciba in 1947, Moll has served as pilot plant chemical operator, junior chemical engineer, chemical engineer.
- Frank E. Myers has been named associate laboratory director of Argonne National Laboratory, Lemont, Ill. Myers is presently dean of the graduate school and head of Lehigh University's physics department.
- Vice presidents Kenneth H. Klipstein and George R. Martin have been elected to the newly created office of executive vice president of American Cyanamid Co.
- Herman C. Zwart has been appointed sales representative for American Instrument Co., San Francisco. He has had varied experience in engineering sales and sales promotion.

### OBITUARIES

- J. Neal Addoms, assistant director of Atlas Powder Co.'s chemical engineering department, died suddenly January 31 in New York City, where he had gone to attend a technical committee meeting of the AIChE. He was 37.
- W. M. Berrell, chief engineer of J. T. Baker Chemical Co., died of a heart attack February 5.

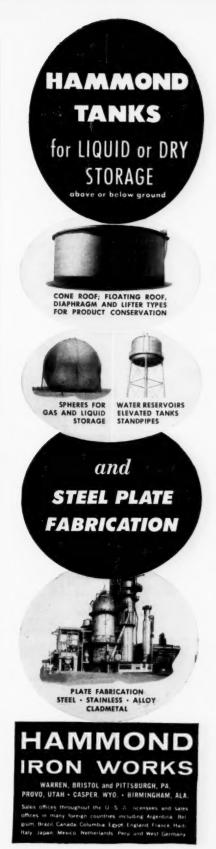
PEOPLE ...

# FIRMS IN THE NEWS

This Month's Top Projects:

- Olin Mathieson is upping sulfuric acid capacity at its Beaumont, Tex., plant with a 500-ton/day addition. Raw material will be spent alkylation acid and H<sub>2</sub>S from nearby refineries; process features ammonium sulfite-bisulfite double-absorption system to recover SO<sub>2</sub> from plant's waste gases.
- Girdler Construction Div. of National Cylinder Gas has just landed a \$3.4-million contract to design and build hydrogen, nitrogen and carbon dioxide production and purification units for Callery Chemical's abuilding \$38-million highenergy fuel plant at Muskogee, Okla.
- U.S. Industrial Chemicals has started construction on a 1-ton/mo. pilot plant at Cincinnati, Ohio, to produce tantalum and niobium via a U.S.I.-developed sodium reduction process. On stream date: April 1958.
- Humble Oil & Refining is expanding its Baytown, Tex., paraxylene unit to 66 million lb./yr. Paraxylene is raw material for such synthetic fibers as Orlon and Dacron.
- Kolker Chemical Corp. has started production of anhydrous methyl chloride at its new plant at Newark, N. J. Annual capacity is 4,500 tons industrial methyl chloride.
- Kennecott Copper Corp. is installing a \$255,000 experimental rod mill at its Arthur, Utah, ore-concentrating plant. Unit will be used in tests to determine if operation is more economical than comparable ball mill.
- Allied Chemical & Dye Corp. has started construction on a new \$1-million sulfuric acid plant at Anacortes, Wash., that will supply acid to adjacent Shell refinery. Fluor Corp. is contractor.
- Petro-Tex Chemical Corp., Houston, Tex., is erecting a 3,000-bbl./day sulfuric acid alkylation plant slated for

- operation in early 1959. Firm has just contracted to supply Plymouth Oil Co. with alkylate when unit goes on stream.
- New Jersey Zinc Co.'s plant at Palmerton, Pa., is adding new facilities for sulfuric acid that will increase annual capacity by 40,000 tons.
- Arthur D. Little has opened an enlarged computing center in Cambridge, Mass., with complete digital computing and data processing facilities.
- A. E. Staley Mfg. Co., Decatur, Ill., is adding two floors and additional process equipment to increase capacity of its new modified starch drying building at the Decatur plant.
- Parke-Davis has announced plans to construct a new 100,000-sq.-ft. manufacturing laboratory and branch office



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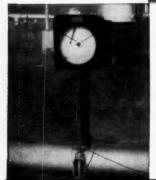
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FIRMS . . .

in Bombay, India, that will turn out essential pharmaceuticals.

Westinghouse is building a new 25,000-sq.-ft. coil manufacturing and repair plant on a 2½-acre site near Utica, N. Y.



G. Barr & Co., Chicago, is now under way with pilot production of pressure-packaged dental creams using nitrogen as propelling agent.

Midwest Research Institute, Kansas City, Mo., has opened a new fire research laboratory that will seek new and improved methods for preventing and fighting fires.

Pittsburgh Coke & Chemical Co. has started ferromanganese production runs from one of its Neville Island, Pa., blast furnaces. Firm spent \$2.5 million converting the unit for 400-ton/day ferromanganese operation.

Lewis-Shepard, manufacturer of fork trucks and materials handling equipment, has added 75,000 sq. ft. manufacturing space to its plant at Watertown, Mass.

Allied Chemical & Dye Corp. is now in commercial production of 15-denier Caprolan nylon carpet staple at National Aniline Div.'s plant at Chesterfield, Va.

General Electric Co.'s Atomic Power Equipment Dept. has completed a \$1.5-million addition to its nuclear fuel element facilities at Schenectady, N. Y. Addition houses production line for forming uranium oxide powder into fuel elements.

The C. P. Hall Co. of Illinois is building a 21,000-sq.-ft. structure in Chicago that will house expanded production facilities for esters, plasticizers, surface active agents and defoamers.

Delhi Taylor Oil Corp. has discovered a large high-grade potash deposit in Grand County, Utah. Plans call for a 6,000-ton/day mill to exploit deposit.

Hilton-Davis Chemical Co. has opened a new sales and service office in Trenton, N. J., that will serve textile industry.



Britain has started round-theclock work on a nuclear power station at Berkeley, England. When operational in 1961, unit will save Britain between one to two million long tons of coal annually.

A. W. Cash Valve Mfg. Corp., Decatur, Ill., has acquired a remodeled 6,000-sq.-ft. building that will house firm's research and engineering departments.

Riker Laboratories, subsidiary of Rexall Drug Co., has ac-

# New uses found for unique properties. of METALLIC OXIDE PIGMENTS



**Product Planning** 



Product Improving

You ordinarily think of metallic oxide pigments being used to produce coloring agents, catalysts, polishing agents and magnetic materials.

Today, however, new product planners and production engineers are finding uses for the unique physical and chemical properties of metallic oxides which are surprisingly far afield from traditional usages.

Below is a review of their characteristics. Look them over. You may get the germ of an idea which will lead to the improvement of existing products ... or to the reduction of new product manufacturing costs.

Should an application suggest itself, write. We'll be glad to cooperate with you in exploring the possibilities. Address Dept. 62, C. K. Williams & Co., Easton, Penna.

#### Name

#### Properties

# Characteristics

Pure Red Iron Oxides and Kroma Reds

Pure Yellow Iron Oxides

Pure Black Iron Oxides

Pure Chromium Oxides (and Hydrates)

Fe<sub>2</sub>O<sub>3</sub>-98.5% SpG.-5.15 Color—Salmon to purplish red

Fe<sub>2</sub>O<sub>3</sub>.H<sub>2</sub>O-99% SpG.-4.03 Color—Lemon to dark orange

Fe<sub>3</sub>O<sub>4</sub>-96% min. SpG.-4.96 Color—Blue Black

Cr<sub>2</sub>O<sub>3</sub>-99% SpG.-5.20 Color—Light to dark green

Natural Oxides—Ochers, Umbers, Siennas, Metallic Browns, Red Oxides Wide range of ferric oxide content and red, yellow and brown colors

Venetian Reds

Fe<sub>2</sub>O<sub>3</sub>-40% SpG.-3.45 Color—Light to medium red

Cuprous Oxide

Cu2O-97% min.

Extenders—Barytes, Calcium Carbonate, Calcium Sulfate,

Wide range

Composition: The basic colors of the iron and chromium oxides are determined by chemical composition. Reds are ferric oxide (Fe<sub>2</sub>O<sub>3</sub>), yellows, hydrated ferric oxide (Fe<sub>2</sub>O<sub>3</sub>.H<sub>2</sub>O); blacks, ferroferric oxide (Fe<sub>3</sub>O<sub>4</sub>); and greens, chromic oxide (Cr<sub>2</sub>O<sub>3</sub>). All these compounds are chemically stable and light permanent.

Particle Shape: Physical properties such as oil absorption and suspension characteristics are dependent on particle shape, controlled by manufacturing processes.

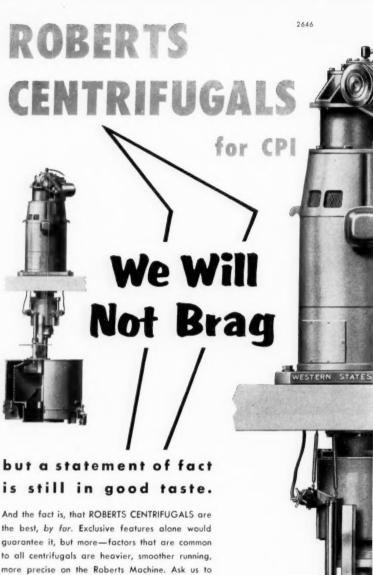
Size: Color range is controlled by particle size—average size increases as color darkens. Uniformity of size determines brightness.

Purity: Freedom from impurities is essential for superior pigment properties and to prevent deleterious effects in end-products. Control of soluble salts, manganese and copper content are an important part of the Williams manufacturing operation.



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Unit No. 2646.





quired an 18-acre tract near Los Angeles and is erecting a \$1.5-million, 5-building facility for research, manufacturing, administration and warehousing operations.

Scholven-Chemie AG. plans to build a polyethylene plant in Gelsenkirchen-Buer, Germany, that will use Ziegler process. Initial capacity will be 6,000 tons yr.

E. H. Sargent & Co. has started construction of a new plant in Springfield, N. J., that will house firm's Eastern Div. when the 37,000-sq.-ft. structure is completed in late spring.



Becco Chemical Div. of Food Machinery & Chemical Corp. has opened a new hydrogen peroxide distribution center in Framingham, Mass. Deionization and demineralization equipment, shown above, purifies water used in diluting hydrogen peroxide to customer specifications.

Dow Chemical Co. has boosted production capacity of foamed polystyrene by 50% at company's plant at Torrance, Calif.

Gulf Oil Corp. announces it will build a 2,000-bbl./day alkylation plant at its Toledo, Ohio, refinery. Contractor, M. W. Kellogg Co., is scheduled to start construction in the summer and unit is slated to be operating in 1959.

El Paso Natural Gas Products' new Ciniza refinery near Gallup, N. M., has gone into production of high-octane gasoline; capacity is about 8,000 bbl./day crude oil.



E. T. Trotter Co. has acquired full ownership of Allied Asphalt & Mineral Corp., compounder of pitches, plasticizers and waxes. Trotter will transfer its manufacturing operations to Allied's plant in Dunellen, N. J.

Vulcan Materials Co. has merged with Union Chemical & Materials Corp. of Chicago boosting Vulcan's net worth to over \$65 million. Vulcan also recently acquired several Tennessee firms.

American Air Filter Co., Louisville, Ky., has completed acquisition of Kennard Corp. of St. Louis through an exchange of common stock. Kennard makes heating and cooling equipment.

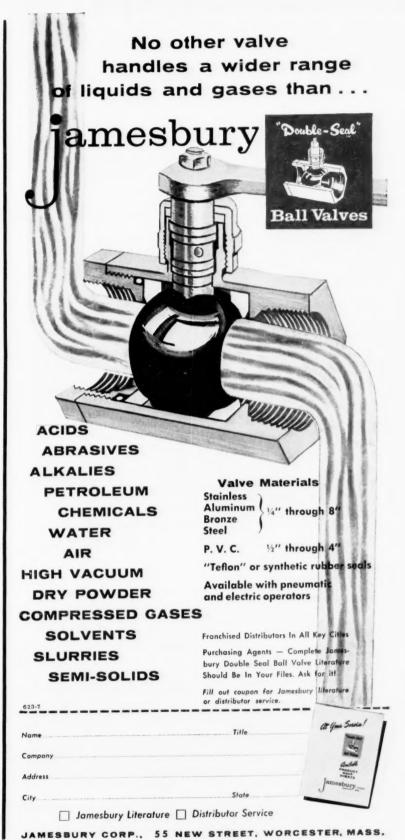
Hanson-Van Winkle-Munning
Co. of Matawan, N. J., has
purchased Alert Supply Co.,
Los Angeles. Alert, manufacturer of buffing compounds,
will operate as a subsidiary
of H-VW-M.

Sundstrand Machine Tool Co., Denver, Colo., has purchased American Machine & Foundry's Turbo Div. at Pacoima, Calif. The Turbo Div. designs and develops auxiliary power supplies for guided missiles.

Rubber Corp. of America has acquired the entire interest owned by Pollak Industrial Corp. in Insular Chemical Corp. of Hicksville, Long Island.

High Voltage Engineering Corp. recently acquired controlling interest in Electronized Chemicals Corp., pioneer in electron processing research.

G. D. Searle & Co., Chicago medical research and pharmaceutical manufacturing firm, has acquired Root Chemicals of Puerto Rico giving Searle access to one of the major



raw materials used in making steroid drugs.

Emery Industries announces acquisition of the Vopcolene Div. of Vegetable Oil Products Co. effective April 1. Vopcolene manfactures diversified line of fatty acids in a Los Angeles plant.

Kennecott Copper Corp. has purchased Consolidated Coppermines bringing two major U. S. copper producers under the same roof. The price: \$8.4 million cash.

Pacific Northwest Alloys is negotiating with General Services Administration for purchase of an electrometals plant at Mead, Wash. Purchase price is expected to be around \$3 million.

Paramount Packaging Corp., Philadelphia, Pa., has purchased all assets of the Flexible Packaging Div., Container Corp. of America.



Foster Grant Co. will manufacture and sell both regular and special types of Bayer nylon-6 under a licensing agreement with Farbenfabriken Bayer of Germany.

Wagner Bros., Inc.'s Equipment Div. is building silicon rectifiers for plating industry; units are permanent and can operate at higher voltages than germanium rectifiers.

Computamatix, Inc., consultants on computer use in business and engineering, are expanding into manufacturing and process control work.

Nicromatic, Ltd., Toronto, Canada, has been licensed to manufacture, distribute and service in Canada the complete line of Ethone products for metal finishing. Black-Clawson Co., manufacturer of pulp and paper machinery, has complemented its line of refining equipment for pulp and paper mills through purchase of the Sutherland refiner, breakertrap and pressure-washer business in the U.S., Canada, and certain overseas markets.

Fluor Products Co. Whittier, Calif., has contracted with Maschinenfabrik Hartmann AG. to design, manufacture and sell the German firm's line of heavy-duty conveying systems.

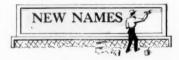


Manning, Maxwell & Moore's Industrial Controls Div. has moved its offices and manufacturing activities to a new 50,000-sq.-ft. plant in Danbury, Conn.

Testing Machines, Inc., has relocated all operations at 72 Jericho Turnpike, Mineola, Long Island.

F. J. Stokes Corp.'s Vacuum Equipment Div. has located its New England sales office at 77 Bedford St., Stamford, Conn.

C. W. Nofsinger Co., engineers and contractors, has expanded operations and moved to new quarters at 307 E. 63rd St., Kansas City, Mo.



Law Engineering Testing Co., Atlanta, Ga., is new name of former Law-Barrow-Agee Laboratories, Inc.

Anatran Co. has been renamed the Digitran Co. and has moved into new headquarters at 45 W. Union St., Pasadena, Calif.

Isotope Chemical Co., Chicago, will be the new name for Nuclear Chemical Co., manufacturer of radiochemicals.



F. J. Stokes Corp.'s International Div. will handle export sales of the package-forming, filling and heat-sealing machinery made by Mercury Heat Sealing Equipment Co.

Dorr-Oliver has expanded pump distributorship of Chemical Pump & Equipment Corp. to include the greater Chicago and greater Cincinnati industrial areas.

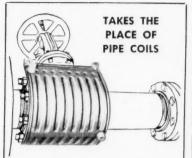


Wm. T. Hand Equipment Co. has been established in Manhasset, Long Island, to supply new and used equipment for chemical and related industries.

Infilco, Inc., has formed Infilco
Pty. Ltd. which will manufacture and market equipment for treating water, sewage and industrial wastes in the Australian-Asian market.

Process & Air Engineering, San Martin, Calif., is a new company specializing in process and air engineering and facility contracting for food and related industries.

Ishikawajima Foster Wheeler Co., formed jointly by Foster Wheeler and Ishikawajima Heavy Industries Co. of Tokyo, Japan, will sell, design, engineer and build plants for Japan's process industries.



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178c Samplers

Important-For pages showing more than one advertised item use the guide to numbers on cards above.

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2169 Mixers, bulletins B-109 & B-107 216f Seals, rotary mechanical

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ON EQUIPMENT AND PRODUCTS IS YOURS FOR THE ASKING COMPLETE PRODUCT INDEX of chemicals, ma-

terials, equipment and services taken from this issue's advertisements and new products departments. You can get more information on any item by circling its code number on one of your Reader Service postcards. EDEE

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The Shriver Vertical Leaf Filter—a new concept in enclosed, pressure filtration equipment—overcomes the limitation on usable filter media and eliminates difficulties in cleaning, if the filter is overloaded.

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FILTER PRESSES · VERTICAL LEAF FILTERS · FILTER MEDIA HORIZONTAL PLATE FILTERS · CONTINUOUS THICKENERS SLAB FORMERS · DIAPHRAGM PUMPS · ELECTROLYTIC CELLS

# CEILCOTE E-900

# ...PROTECTIVE COATING FOR:

STRUCTURAL STEEL . . . TANK EX-TERIORS . . . WATER TANK INTE-**RIORS...TANK TRUCK EXTERIORS** ... STACKS ... EXHAUST FANS ... CONCRETE PIERS FOR PLATING **FOUNDATIONS . . . FLOORS UNDER** STORAGE TANKS . . . BUILDING WALLS . . . PIT WALLS.

E-900 is truly an outstanding coating. It provides unusual resistance to a wide variety of chemicals, acids, alkalies and solvents.

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New coating can be applied by brush or roller coat after addition of a hardening agent. Because of high solid content, 95% of applied thickness is converted to protective film.

E-900 is an exclusive development of CEILCOTE . . . a name long recognized as leader in the corrosion industry.





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# READER SERVICE . . .

# TECHNICAL LITERATURE

EDITED BY N. J. DEGENHARDT

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# Chemicals

- Acylase I.....Acylase I, an enzyme obtained from hog kidneys and capable of separating many synthetic di-amino acids, is now available in developmental quantities. Request TD 1335.

  93-4j

  \*U. S. Industrial Chem. Co.
- Alumina Products....Bulletin 108
  lists uses and applications of high
  alumina products—standard brick,
  special shapes and ramming mixes.
  Detailed information on Ironton
  AL-70 and HI-AL ramming mix.
  193A Ironton Fire Brick Co.
- Alumina Silicates.....Bulletin 1257 summarizes chemical properties, compatibilities, physical properties, dehydration reactions of Microcite, Ser-X and Ser-A-Sil hydrous alumina silicates. 193B Summit Mining Corp.
- Antifoam Agents.....Three antifoaming silicones—Anti-foam 60, primarily for aqueous systems; Anti-foam SS-66, for nonaqueous systems; Anti-foam SS-24, for nonaqueous and special systems—are offered by GE.

Harwick Standard Chemical Co.

- Anti-Mildew Chemical.....Linen service companies can protect their rental goods from mildew damage for 1½ cents per 100 lb. of wash, according to producer of Santobrite, mildew-combatting compound.

  1930 Monsanto Chemical Co.
- Catalyst, Fuel Oil.....Harcoite fuel oil catalyst makes possible, with one treatment, prevention of soot and slag deposits from fire-side of boiler while preventing sludge buildup in storage tank.

  193E Harco Chemical Co.
- Ceramics, Sprayed.....Chemically inert ceramic coatings, for parts and equipment, are resistant to corrosion, abrasion and erosion under wide range of temperatures and pressures. 193F Chemical & Power Products.
- Electrochemicals.....Company's zirconium compounds can be used as source materials, metallurgical additives, cermet compounds, etc. These and other electrochemicals are discussed in booklet. 166 \*Norton Co.

\* From advertisement, this issue

Enzymes, Flavor.....A method for restoring the flavor of processed foods by adding flavor enzymes is described in a reprint. The studies were carried out on cabbage and related foods. TD 1339.

93-4n °U.S. Industrial Chem. Co.

Fat Rancidity....."A Nice Fat Problem" includes discussion of current theories on rancidity, present status of research on antioxidants and expected progress in combatting this problem. 193G

Evans Research & Development.

Fatty Alcohol Sulfates.....25 p. booklet contains typical analyses and distinguishing features for Sipon sodium and other lauryl sulfates and sodium alkyl sulfates. Includes sections on physical data. 193H American Alcolac Corp.

Fluorides.....Company offers a free copy of M. C. A. Chemical Safety Data Sheet SD-25 on properties and essential information about hydrofluoric acid, anhydrous and aqueous. Request a copy.

75 \*Harshaw Chemical Co.

Halogen Fluorides.....The halogen fluorides, now commercially available, are the most reactive chemicals known, except for elemental fluorine. Request a copy of Technical Bulletin TA-8532-2. 59 \*Allied Chemical & Dye Corp.

Hand Cleaners, Waterless . . . . 4 p. formulation guide for waterless hand cleaners discusses market for compounds, principal types and ingredients, typical formulations (gel and lotion type).

1931 Atlas Powder Co.

\* From advertisement, this issue

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# RIGHT ANGLE GEARMOTORS MOTOREDUCERS



RIGHT ANGLE GEARMOTOR — Horizontal or Vertical Drive, 8 sizes, ratio 6:1 to 100:1, ½ to



RIGHT ANGLE MOTOREDUCER— Horizontal or Vertical Drive, 8 sizes, ratio 6:1 to 100:1, 1/3 to 30 horsepower.

70<sup>th</sup>

THESE D.O.James Right Angle Gearmotors and Motoreducers are of the same construction and high quality as the individual Gear Speed Reducers which we have been producing for so many years. They cover a very wide range of ratios, horsepowers, and are an ideal, compact, efficient unit for many power and space-saving installations.

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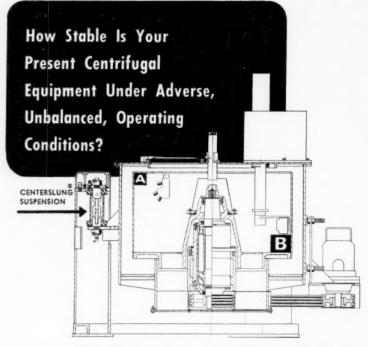
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# SEND FOR CATALOGS

Catalogs, price lists and selection tables of gearmotor speed reducers and motoreducers are available to power transmission engineers. Please request on company Letterhead —we'll mail your copy at once.



Section of new Tolhurst Batch-O-Matic® combining for the first time Centerslung® suspension with bottom discharge, PLUS fully timer-controlled automatic batch programming.

Will your centrifugal equipment operate safely -

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The new Tolhurst Batch-O-Matic Centrifugal passed these tests with no appreciable vibration being transmitted to the foundation - only a smooth oscillation on a horizontal plane and no vertical jumping. That's real assurance of Tolhurst's stability in handling all materials, free or slow-draining, even the toughest jobs. This big operating advantage is provided by exclusive Centerslung mounting - the highly stable suspension that minimizes bearing wear, downtime and other maintenance problems resulting from excessive vibration.

For help in connection with your centrifuging problems, call in your nearest Tolhurst representative. (He is listed in Chemical Engineering Catalog.) Or, write us direct.

# Tolhurst CENTRIFUGALS

American Machine and Metals. Inc.

Specialists in liquid-solids separation Dept. CET-358, East Moline, Illinois

- Herbicides.....Weeds and brush along power lines, pipelines, industrial sites can be cleared chemically with formulations of 2, 4-D and 2,-4, 5-T herbicides at two-thirds cost of hand or mechanical cutting. Monsanto Chemical Co.
- Molykote, Type BR-2, is lithium-soap-base heavy duty lube combining excellence of calcium and sodium soap thickners with lubricity of molybdenum disulfide powder. Bulletin 114.

  194B Alpha-Molykote Corp.
- Methionine . . . Methionine as a supplement in the diet of growing turkeys is the subject of a booklet designed to assist the commercial nutrition-ist in preparation of rations for turkeys.
- rochemicals.....4 p. product folder contains specification sheets on Delhi-Taylor's high purity, nitra-tion grade benzene, toluene; 5° xylene; high aromatic solvents; mineral spirits. 194D Delhi-Taylor Oil Corp. Petrochemicals...
- Phosphate, Oil Field.....Calgon 15-J is a controlled solubility phosphate used in the downhole treatment of producing oil wells. Bulletin 41011 describes properties, examples of applications. 194E Calgon Co.
- Plastics.. stics......1958 edition of "Con-densed Reference File" is profusely illustrated and has thumb-indices to aid in finding data on Bakelite's polyethylenes, vinyls, styrenes, polyethylenes, v phenolics, epoxies. 194F Bakelite Co.
- Plastics Packaging... "1958 Guide to Improved Packaging" illustrates low-cost packaging with plastics for both product protection and eye appeal. Polyethylene, vinyl, polyappeal. Polyethylestyrene discussed.
- wood Data.....Three additions to redwood data book include: exterior finishes supplement, 1958 Sweet's Catalog (replacing old 1957 catalog) and table of contents of all data sheets you should have. 194H California Redwood Assn. Redwood Data.
- Rubber, Silicone.....K-1044R is the only commercially available silicone only commercially available sincone rubber compound passing AMS-3301B specifications. 6 p. data sheet describes compound's features and properties.

  1941 Union Carbide Corp. Union Carbide Corp.
- cone Compound.....New silicone compound containing salicyl groups in its structure can now be obtained. Said to provide sun-screening action; not easily washed off in water. TD 1333.

  93-4h \*U. S. Industrial Chem. Co. Silicone Compound.
- Silicone, Epoxy.....Syl-Kem 90 is a difunctional epoxy silicone offering organic chemists a means of introducing siloxane linkage into organic structures. Bulletin Q-2-101 lists properties, reactions. Dow Corning Corp.
- Sodium Chlorate ..... Properties and safe handling practices of sodium chlorate—used in uranium processing and chlorine dioxide pulp bleaching—are described in Technical Bulletin C-5001. Pennsalt Chemicals Corp.

<sup>\*</sup> From advertisement, this issue

Varnishes.....Polyethylene containers can be coated with a varnish said to cut static, give sheen, prevent scuffing. Another coating reduces oil permeability and gives glassy clarity. Send for TD 1331. 93-4f \*U.S. Industrial Chemicals Co.

# Construction Materials

Coating Compounds.....4 p. brochure describes regular, extra-resistant and floor surfacing grades of penntrowel coating compounds. Product features ease of use, fast curing inseparable bonding.

195A Pennsalt Chemicals Corp.

Coatings, Protective.....E-900 resists a variety of chemicals, acids, alkalies and solvents. It can be applied by brush or roller coat after addition of a hardening agent. Bulletin E-900.

Coatings, Protective.....Outstanding characteristics of IFCO coatings include tremendous adhesion, durability and wear resistance; high immunity to moisture; air-drying speed of 5 to 10 minutes.

195B Industrial Finishes Co.

Fabrication.....Company is noted for tough pressure vessel welding jobs like two identical 100-ton pressure vessels for a modern refinery. Send for a copy of Weldment Bulletin 7001. 101 \*Baldwin-Lima-Hamilton.

Floors, Corrosion Resistant.....Atlas industrial floors are made of an impervious membrane and acid-proof brick, joined by corrosion-proof cements on a sound concrete base.

Request Bulletin 3-3.

195C Atlas Mineral Prods. Co.

Insulation, Ceramic Fabric.... Ceramic woven fabrics for high-temperature insulation will withstand heat up to 2,000 degrees F. Made of aluminum silicate fiber, lightweight, flexible. TD 1332.

93-4g \*U. S. Industrial Chem. Co.

Iron, Ductile . . . . "Ductile Iron Digest" describes new metal as strong as carbon steel, tensile strength to 200,000 psi. It can be twisted or bent without cracking; has up to 30% elongation.

195D International Nickel Comments.

Paint . . . . . Bulletin 760 gives full technical data on Tygon paints together with performance data under exposure to over 150 corrosives. Tygon paint adds years to equipment life. 52 "U. S. Stoneware Co.

Paint.....Acrylic emulsion paint behavior under test exposure in every climatic region of the U. S. is reported in a 56-page brochure. Detailed summaries, photos and tables. TD 1337. 93-41 \*U. S. Industrial Chem. Co.

Putty, Metal.....Flawmaster epoxybased metal putty is used to fill blowholes in both machined and raw castings; eliminates sand pits, shrinkage cracks, etc. in precision metal parts. Bulletin CE. 195E Carl H. Biggs Co.



# 24,830 successful installations!

# EASTERN D-11 CENTRIFUGAL PUMP

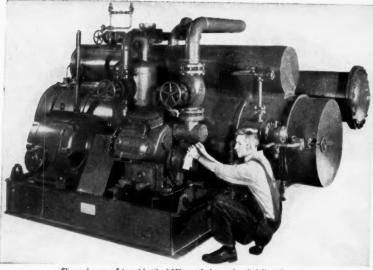
Why is the D-11 so successful among original equipment manufacturers? Size and weight make it ideal. The D-11 is the smallest, close-coupled, single-stage centrifugal pump available with an induction type motor. Eighteen pounds of compact design (9¾" x 4½") make it excel in industrial and process equipment, as well as laboratory service, and pilot plant operations.

#### SPECIAL METALS

A full selection of metals make the D-11 and other Eastern Centrifugal Pumps versatile performers. Available in 18-8 Type 303 and Type 316 Stainless Steel, Monel, Hastelloy "C", Cast Iron and Bronze, Eastern Pumps range from 1/8 th to 3/4 H.P. with capacities up to 70 G.P.M., pressures to 65 P.S.I.



<sup>\*</sup> From advertisement, this issue



Shown is one of two identical Vilter ethylene glycol chillers factory assembled as a packaged unit for a large chemical company.

# NOW, large-size, "packaged"

# VILTER

# **HEAT EXCHANGERS** to meet your exact specifications

The above ethylene glycol chiller built for a large chemical company is factory assembled as a packaged unit. The principal Vilter components include: an 8-cylinder VMC ammonia compressor, 24" x 14' ammonia condenser, 12" x 12' liquid ammonia receiver, 30" x 12' flooded ethylene glycol chiller capable of cooling 405 gpm of 30% ethylene glycol solution from 25°F. to 20°F. The chiller has a 16" surge drum integrally welded to it. All electrical equipment is installed in explosion proof enclosures. It is typical of the custom work Vilter is doing in the field of heat exchangers and pressure vessels to meet design and budget requirements.

Vilter makes all four basic types of heat exchangers: shell and coil, shell and tube, shell and tube bundle, and atmospheric . . . and in every possible modification. Vilter can give you the most efficient heat exchange equipment with working pressures as high as 10,000 psi. Vilter is equipped to build vessels in conformance to both the A.S.M.E. Code and T.E.M.A.

Today, more than ever before, the leading names in both the chemical and petroleum industries are turning to Vilter for their special vessel needs. Consult with Vilter about your needs.

Write for these helpful bulletins to The Vilter Manufacturing Company Dept. K-718, 2217 S. First Street, Milwaukee 7, Wisconsin







Bulletin 707 Brine Coolers Heat Exchangers

THE VILTER MANUFACTURING COMPANY, Milwaukee 7, Wisconsin

Air Units . Ammonia & Freen Compressors . Booster Compressors . Baudelot Coolers . Water & Brine Coolers . Blast Freezers . Evaporative & Shell & Tube Condensers . Pipe Coils . Valves & Fittings . Pakice & Polarflake Ice Machines Tile .Impervo line of brick, floor brick and quarry tile is designed to meet the most severe industrial and commercial requirements. Offers highest resistance to chemicals, wear and impact.

# Electrical & Mechanical

rings, Hanger ..... Graphalloy hanger bearings for industrial con-veyor rolls are used in high-temperature equipment where oil and grease would volatize, causing prodcontamination or fire.

B Graphite Metallizing Corp.

Generators, Package . . . . Cyclotherm's Cyclonic Combustion principle— means of burning fuel and trans-ferring heat—is incorporated in line of package generators for forced circulation, hot water systems.
196C Cyclotherm Div.

Motor Insulation, Silicone . . . . Company offers a list of motor builders who make motors insulated with Dow Corning silicones. Both ac and dc motors are available in standard frame sizes. Free. 100 \*Dow Corning Corp.

Motors, Induction . . . . Large induction motors—in ratings from 150 to 1,250 hp.—fill demands imposed by larger process machinery and in-dustrial operations. Bulletin 1950 describes such motors. Louis Allis Co.

Motor, Induction . . . . . Syncro-Spede motor is built in same NEMA frame size as standard motor of equal hp.
It accelerates as induction motor, but runs at synchronous speed sans permanent magnets, d.c. excitation.

196E Louis Allis Co.

Motors, Pump......Totally protected pump motors, from ½ to 1,000 hp., are discussed in Bulletin B-2507. Explains Partial Motor concept for attaching machined motor frame to pump frame to form integrated Reliance Electric & Eng. 196F

Mounting Pads.....Shear-flex mounting pads offer easy, efficient, economical way to eliminate lagging to floor and reduce noise and vibration transmission. Pads fit under legar bearing plate of machine. or bearing plate of machine. Vibration Mountings

Rectifiers . . . . Excitron mercury arc rectifiers come in a choice of sealed or pumped tubes in either open or enclosed construction, with an internal cooling system, easy operation. Bul. 12B8494.

111 \*Allis-Chalmers Mfg. Co.

All-steel Falk ucers, Motor . . . . All-steel Falk Motoreducers have large overhung mourequeers have large overhung load capacity, precision gearing, extra-capacity gearing, sealed hous-ings, positive lubrication. Request free Bulletin 3100.

\*Falk Corp.

rters.....Type ZHS starters are specifically designed for dusty, cor-rosive atmospheres. The high in-terrupting capacity ZHS contactor operates under oil. Send for free Bulletin 8130-CH. Starters \*Elec. Controller & Mfg.

<sup>\*</sup> From advertisement, this issue

Starters, Motor.....Automatic auto-transformer is used in open delta to reduce line voltage. Taps on transformer to reduce voltage. Rat-ings to 300 hp., 220 v.; 600 hp., 440-550 v. Bul. 746. \*Allen-Bradley Co.

Starters, Motor.....Manual autotrans-former motor starter has air break, silver alloy contacts. Rated 75 hp., 220 v.; 150 hp., 440-550 v. Also made with oil-immersed contacts. \*Allen-Bradley Co. 104b

Starters, Motor......Manual stepless resistance starters have graphite compression disc resistors for stepless starting and are operated by hand levers. Ratings to 200 hp.; 220-440-550 v. Bul. 640.

104c \*Allen-Bradley Co.

ters, Motor.....Part winding starters for use with suitable squir-rel cage motors having separate Starters. parallel stator windings. Ratings to 200 hp., 220-440-550 v. Send for Bulletin 736. \*Allen-Bradley Co.

Starters, Motor.....Automatic step-less resistance starters have graphite disc resistors automatically inserted in line for smooth starting. Ratings to 200 hp., 220-440-550 v Bul. 740. \*Allen-Bradley Co. 104e

Transformers, Variable.....The type 10 Powerstat variable transformer is a compact variable A-C voltage control for low wattage applica-tions. Bulletins P252 has demen-sions, drawings, data.

197A Superior Electric Co.

Selts....."V-belts, the Testing, Inspection and Control of their Quality" describes in words and pictures how raw materials and finished belts are inspected. Booklet S-51107 V-Belts belts 51107. 197B

Goodyear Tire & Rubber Co.

# Handling & Packaging

Conveying Machinery..... Catalog 610 describes specifications, application information and selection data on CHAIN Belt products for power transmission, conveying and elevating service.

Chain Belt Co.

Elevating Forks..... Automatic elevating forks (EF-4) for low-mast lift ing forks (EF-4) for low-mast lift trucks increase maximum lifting height and retain low collapsed height. Four models ranging from 2,000 to 10,000-lb. capacity. 197D Little Giant Products.

ers....Company's fillers are accurate to plus or minus 0.1 ounce by liquid volume. They eliminate spillage completely and need no maintenance beyond routine cleaning. Bul. 878 & 964.

16-7a \*Pfaudler Co. Fillers..

Materials Handling .... New folder, packed with timely engineering in-formation, includes data on some of latest accessories available for of latest accessories available for speeding materials handling opera-tions. Request a copy. 197E Towmotor Corp.

FREE. Send for the G.T.A. Library of Product Information G.T.A. . . . Means Gaulin Technical Assistance - best source on how to mix or move your product.



Sub-Micron Dispers Bulletin SMD-55



Colloid Mill Bulletin C-57



story Homoge Bulletin LH-55

# **New Tricks for old** blends with Gaulin PARTICLE CONTROL

Get the jump on costs and quality! See what a Gaulin Homogenizer or Colloid Mill can do for vou

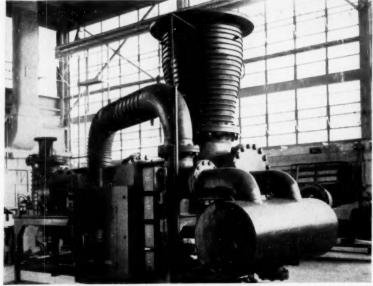
- · Pharmaceuticals: more uniform, stable and finer emulsions.
- · Grease: increases penetration value and uni-
- Cosmetics: produces smoother textures, longer shelf-life, locks-in fragrance.
- Wax Emulsions: less emulsifying agent required, increases stability.
- Pigments: produces continuous, high capacity dispersions to finest possible particle size.

Try Homogenizing your product. Send a sample or rent Laboratory Homogenizer for only \$75.00 a month. Gaulin Technical Assistance will help you bring new cost-saving solutions to processing operations.



71 Garden Street, Everett 49, Mass. World's largest manufacturer of stainless steel reciprocating, rotary, pressure exchange pumps, dispersers, homogenizers and colloid mills

OMOGENIZING genizer Bulletin H-55



Three-stage oil diffusion-ejector pump, Type KS-16,000.

# Why high vacuum $is\ like$ Hi-Fi

Both high vacuum and Hi-Fi are achieved through a finely tuned system. When you buy, you match components to get the performance you want at the price you can pay.

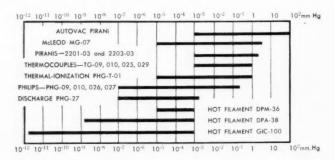
In high vacuum as in Hi-Fi, it helps when you can select components from the widest possible lines.

CEC offers the greatest choice of high-vacuum components available:

77 different pumps. Oil ejector, diffusion, diffusion-ejector; mercury diffusion, Evapor-ion or mechanical-you can buy a CEC pump that fits in your hand or you can move all the way up the line to the giant illustrated which pumps

1,000,000 micron-liters a second.

17 different gauges. You can match pump performance with vacuum measurement exactly from this complete line of CEC McLeod, thermal, and ionization gauges. Chart shows ranges.



67 valves, baffles, and traps. Valves: Globe, quarter-swing, right-angle, gate, and ultra-high vacuum. Combination valve-baffle. Baffles: Cooled by water, Freon, or liquid nitrogen. Traps: Glass, dust, and copper foil.

We'll be glad to send bulletins on CEC components that interest you.



# Consolidated Electrodynamics Rochester Division, Rochester 3, N. Y.

formerly Consolidated Vacuum

SALES AND SERVICE OFFICES IN PRINCIPAL CITIES

Scale, Bagging.....Product data sheet describes GA-17 high speed gross bagging scale with automatic or semi-automatic delivery. Sheet al-so specifies materials which scale can handle. Sheet 5701. Richardson Scale Co.

cks, Fork Lift......Circular 37 points out how maneuverability has been incorporated into electric fork lift truck through rear-wheel drive and by recessing the mast between lead wheels Trucks. tween load wheels.

198B Lewis-Shepard Products

# Heating & Cooling

Exchangers. . Bulletin holds complete technical details on Hi-Transfer heat exchangers, in-cluding unit diagrams, pressure tables and specification data. Nontables and specification. ferrous construction. \*Whitlock Mfg. Co.

Heat Exchangers.....Company offers Bulletin 707, on condensers, brine coolers and heat exchangers, and Bulletin 427, on industrial heat exchangers. They make four basic types of exchangers. 196 \*Vilter Mfg. Co.

ters.....Industrial unit heaters have fourteen basic coil sizes to give you the optimum selection for either steam or hot water. Can be mounted on floor, wall or ceiling. Catalog 1510-2.

3 \*Westinghouse Electric Corp. Heaters . .

ders......"Nocordal Impervious Graphite Heat Transfer Equipment for Corrosive Chemicals" describes heat exchangers, immersion heat-ers, jet agitators. Diagrams suit-able for preliminary design work.

Heil Process Equipment Corp.

Heating Systems, Dowtherm .... FW
vaporizers using Dowtherm cut the
costs of high-temperature, lowpressure heating in over 500 applications. Oil, gas or electrical
units. Bul. ID-54-5.
65 \*Foster Wheeler Corp.

Thermo-Panels ..... Form V-2 tells of the Thermo-panel coil valve warm-er or cooler; Bulletin 355 has 52 pages of technical data on thermo-panel coils; Bulletin 258 has prices and design data.
TL185 \*Dean Products Inc.

ps, Steam.....The 44-page Armstrong Steam Trap Book covers the excellent air handling characteristics and other features of company's steam traps. Also trap selection and installation.

49 \*Armstrong Machine Works. Traps, Steam...

# Instruments & Controls

Analyzer, Infrared ...... New infrared analyzer for measuring concentrations of gases of medical interest such as carbon dioxide is expected to be used in pulmonary and anesthetics research. TD 1338.

93-4m. \*U. S. Industrial Chem. Co.

<sup>\*</sup> From advertisement, this issue

- Controllers .... Transcope plug-in controller is especially suited to the short spans of measurement encountered in present-day processing. Response to adjustments is fast. Bulletin 98278.

  158a \*Taylor Instrument Co.
- Controls, Temperature . . . . . Remote bulb temperature controls are simple, reliable and accurate. Illustrated Catalog Section 200 contains information, specifications and drawings of several types.

  199A United Electric Control
- Electrophoresis, Paper.....8 p. catalog describes Model R system for analysis by paper-strip electrophoresis. Covers use of technique in analyzing materials, particularly biochemicals. Form SBR-25 199B Spince Div.
- Flow Meters.....Bulletin of engineering data on differential pressure type flow meters gives basic information and theory on selection, sizing and installation of various primary devices. Bulletin F1607.

  1990 Bristol Co.
- Instruments.....A line of gages is available for measuring draft, pressure, differential gas pressure and temperature for use as receivers with pneumatic transmitters. Bulletin 806.

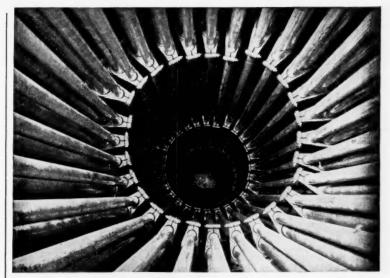
  99 \*Republic Flow Meters Co.
- Manometer Protection . . . . Mercureceiver prevents loss of mercury from manometer tube, smooths out pressure impulses and fluctuations, makes possible steady average pressure reading. 1990 Chemiquip Co.
- Recorders . . . . Transcope plug-in recorder is a companion instrument to the Transcope controller. No other recorder, regardless of size, puts so many features in so little panel space. Bull. 98272.

  158b \*Taylor Instrument Co.
- Thermal Conductivity Unit.....Series
  200 unit is simple, reliable instrument for process stream monitoring. Primarily used to measure
  binary mixtures; also suited for
  complex mixtures. Bulletin 200.
  1996 Analytic Systems Co.

# Pipe, Fittings, Valves

Nozzles, Spray.....Company gives you better spray nozzle performance and a wide choice of physical nozzle shapes, sizes and assemblies. Also helps with installation, maintenance. Cat. 24.

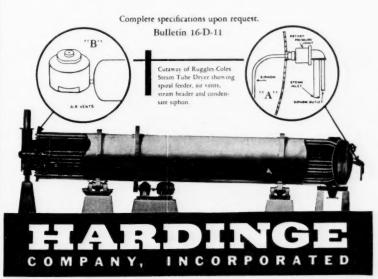
T205 \*Spraying Systems Co.



# Ruggles-Coles STEAM

# TUBE DRYERS

- Ruggles-Coles Steam Tube Dryers have been supplied fabricated of aluminum, nickel, monel, inconel, stainless steels and other alloys to provide protection against corrosion and contamination. All fabrication is to code requirements.
- The continuous siphon discharge of condensate is independent of speed of rotation of the shell. (See "A")
- Automatic air vent for each tube eliminates loss of tube heating surface at the feed end of the dryer. (See "B")
- These extra advantages of the Ruggles-Coles Dryer mean continuous maximum output without operating attention and elaborate control devices.



YORE, PENNSYLVANIA • 240 Arch St. • Main Office and Works
New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • San Francisco

<sup>\*</sup>From advertisement, this issue

# **NUGENT PRODUCTS**

for the Chemical Industry

# BAG-TYPE FILTERS

These Nugent bag-type filters are ideally suited for filtering amine solutions such as Monoethanolamine, Diethanolamine, and Diethylene-Glycol. Also adaptable for other corrosive substances. All metal parts of the filter cartridge are stainless steel, providing excellent corrosion resistance. Will remove foreign solids as small as .0007" while filtering all the fluid incirculation every cycle. Available in single or duplex models in a wide range of sizes.



Fig. 1116HA-4L

# STAR-SHAPED EXTENDED AREA STRAINERS

Nugent star-shaped extended area strainers are offered with brass, steel or stainless steel screens for corrosive service. Available in single and duplex models with wide capacity range.



Strainer Fig. 1490AM-O uses Fig. 1490AW-O basket. Rated for 50 psi working pressure. Capacities: 12-25 GPM. 100 mesh or coarser. Fig. 1490W-4R, 45 and 4L are high pressure strainers rated for 600 psi working pressure. Use Fig. 1490CN baskets of corresponding size. Capacities: 65-468 GPM. 100 mesh or coarser.

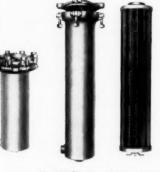


Fig. 1490DD-4L strainer uses one 1490CN-4L bosket. Sizes 4R and 4S are same style. Larger sizes available. 125 psi working pressure. Capacities: 65-7500 GPM. 100 mesh or coarser.

# SIGHT FLOW INDICATORS

Fig. 1366E fittings are for indicating the flow of liquid in a pipe line. Has spring compensated, hinged, indicator gate which moves in proportion to the flow and is visible from either side, even when liquid is dark or discolored. Windows easily removed for cleaning. May be supplied with electrical contacts to operate an alarm bell or light if liquid flow should stop. Available in brass, cast iron, steel or stainless steel.



For complete information send outline of your requirements.



REPRESENTATIVES IN

PRINCIPAL CITIES

WMo Wo NUGENT & GOOD DIGO 3458 CLEVELAND STREET, SKOKIE, ILLINOIS

OIL FILTERS . STRAINERS . TELESCOPIC OILERS
OILING AND FILTERING SYSTEMS . OILING DEVICES
SIGHT FEED VALVES . FLOW INDICATORS

LITERATURE . . .

Pipe & Fittings, Glass.....Composition and structure of glass pipe make it ideal for chemical, pulp and paper, petroleum refining industries. Pipe and fittings described in Catalog SG-11. 200A Sentinel Glass Co.

Valves.....Multiport valves are used in the process industries for batching, blending and product flow control. Efficient where flow must be stopped, changed or relieved. Bulletin V-203. 97 \*Rockwell Mfg. Co.

Valves.....Vogt GP valves have seats faced with hard facing alloys and hardened wedges. They feature the toughest and smoothest seating surfaces obtainable anywhere. Supplement 1 to Catalog F-9. 120 \*Henry Vogt Machine Co.

Valves.....Series of folders, "The Evidence in the Case," reports on the performance of LQ600 valves in unusually severe applications. Details problems, solutions, results experienced in chemical industry.

200B Lunkenheimer Co.

Valves, Ball.....Illustrated Rockwood full, round flow ball valve folder describes line including the stainless steel ball valve, steam valve, regular forged valve, etc. Request your copy. 176 \*Rockwood Sprinkler Co.

Valves, Bali....Double-Seal ball valves handle a wider range of liquids and gases than any other valve. They take care of acids, abrasives, chemicals, solvents, slurries, etc. Literature. 183 \*Jamesbury Corp.

Valves, Ball......Exclusive "Double-Seal" action of ball valves provides complete shut-off on both sealing surfaces of the ball. They handle a wide range of liquids and gases. Data sheets. 200C Jamesbury Corp.

Valves, Glassed . . . . New flush valve has one-piece glassed head and stem, with rigidized Teflon-glass fiber seat. Ball-joint construction gives positive, leakproof sealing. Data sheet 42.

16-7b \*Pfaudler Co.

Valve, Purge Sequence.....Steam purge sequence valve provides secure, hazard-free means of purging or scouring oil burner tips in industrial installations. Flyer contains diagrams and valve photo.

200D Atlas Valve Co.

Valves, Safety Relief..... A durable, two-ply stainless steel sealing bellows in safety relief valves isolates contaminants, corrosion or viscous fluids from the working parts. Catalog 1900.

67 \*Manning, Maxwell & Moore.

Valve, Transfer.....Cash Standard
Type 45 duplex transfer valve provides fast, smooth transfer from
one strainer or heat exchanger to
another. Bulletin contains design,
performance information.
200E A. W. Cash Co.

Valves & Fittings, PVC.....Company's valves and fittings are made of non-aging, non-corrosive and non-toxic unplasticized rigid polyvinyl chloride. Highly resistant to chemical attack. Bklet.

118 \*Walworth Co.

\* From advertisement, this issue

# Process Equipment

- Pollutions Control . . . . Oxy-Catalyst systems for air pollution control and waste heat recovery can clean up close to 100% of combustible pollutants and odors. Send for brochure with facts & figures.

  BL185 \*Oxy-Catalyst Inc. Air Pellutions Control .
- tators, Tank Top.....Tank top agitations increase productivity, lower power costs and minimize maintenance requirements. Seven sizes are available, with a full range of speeds. Bul. 551. Agitators, Tar agitations \*New England Tank & Tower.

- Agitators & Mixers . . . . Patented stand-pipe around propeller shaft of agitators and mixers assures posi-tive agitation and circulation. Heavy duty and acid-proof con-struction. Bulletin A2-B4. 178a \*Denver Equipment Co.
- .Roberts centrifugals Centrifugals... trifugals.....Roberts centrifugals have exclusive features, and the factors that are common to all centrifugals are heavier, smoother running and more precise in them. Request Data Unit 2646.

  182 \*Western States Machine Co.
- Centrifuges.....Centrifuges for de-watering, concentration and class-ification of solids in slurries, sludges and suspensions. Data File 1286 on Nozljector and File 1285 on Super-D-Canter. 6-7 \*Sharples Corp.
- Centrifuge, Screening.....Mercone cen-trifuge provides continuous high trifuge provides continuous high capacity dewatering and screening; uses high centrifugal force to overcome capillary attraction of liquids to solids.

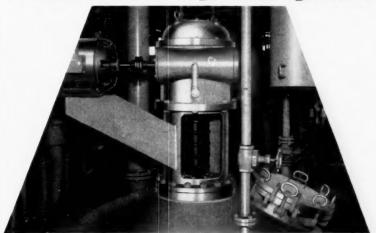
  201A Dorr-Oliver Inc.
- Chlorinator . . . . . Features, construc-tion and application of vacuum-type, solution-feed, high capacity gas chlorinator are described in Catalog 70-15. Chlorinator capa-cities: 60-8,000 lb. Cl per day. 201B Fischer & Porter Co.
- Condensers.....Line of low-level con-densers for condensing steam under vacuum, at ground level, doesn't require barometric leg. Bulletin 5AB includes sizing data for both eductor and multi-jet condensers. 201C Schutte & Koerting Co.
- Crushers, Jaw ..... Forced-feed crushers have cast steel frame, manganese jaw and cheek plates. Large diameter shafts reduce shaft deflection. Settings easily controlled. Bul. C12-B12. 178d \*Denver Equipment Co.
- Crushers, Single Roll......Single roll crusher has been used for reducing glass, plastics, coal, carbon, sulphur, clay, silica gel and other difficult to handle materials. Bul. 116-A. 43e \*Sprout, Waldron & Co.
- Dryers.....A Kemp Oriad or Convection type dryer will give you high efficiency drying for guarding pneumatic instruments, drying gases and inerts, pressurizing anhydrous liquids. Bul. D-100.

  83 °C. M. Kemp Mfg. Co.



# GET PRODUCT UNIFORM

NETTCO **Engineered Agitation!** 



INCREASE PRODUCTIVITY, lower power costs, and minimize maintenance requirements . . . with "process-rated" Model WT agitators by Nettco. Standardized components (motor, drive, shaft, stirrer) can be combined to suit your most exacting size, speed, HP or other process specifications. Check the design features of the Model WT tank top agitator . . .

- Worm gear reduction drives
- Ratios from 3.5:1 to 68:1
- Seven sizes available
- Complete range of speeds
- Minimum moving parts
- Large diameter vertical shaft
- Widely spaced, oversized Timken bearings
- Fully enclosed dust, fume, moisture-proof
- · Splash lubrication, drip-proof design
- Oil-trapped against leakage

Model T units, featuring helical gear trains and worm gears in combination, offer ratios from 6.25:1 to 100:1 in numerous "process-rated" models designed for dependable, economical operation. Ask Nettco agitation engineers for recommendations. Request Bulletin 551 and data sheet from New England Tank & Tower Company, 87 Tileston Street, Everett 49, Mass.





# FREE LITERATURE

Please send me the following literature:

- ☐ Tank Top Agitators—Bulletin 551 □ Portable & Tripod Mixers—Spec. Sheets
- ☐ Pipeline-Flomix®-Bulletin 531
  - Side Entering-Bulletin 532



Against (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>

# **KENNAMETAL**\* components last 2 to 6 times longer...

On Unloader Knives: When processing corrosive Ammonium Sulfate (Coke Plant), the best life of any material tried for unloader knives on this crystal dehydrator was less than three months.† With Synthetic Ammonium Sulfate, the knives lasted little more than a month. By changing to knives made from Kennametal hard tungsten carbide, service life has been increased to twelve months or more with Coke Plant Sulfate, and up to four months with Synthetic Sulfate.

On Distributor Tips: With sulfates of either kind, Kennametal Distributor Tips in the feed assembly last up to eight months-double the life of any

other alloys tried. Kennametal parts cost less in terms of longer life, increased production, and less downtime.

Chances are Kennametal can help you solve a problem involving corrosion, abrasion, erosion, or contamination. The Kennametal "family" of hard carbides includes grades three times as rigid as steel . . . grades that last up to 60 times as long as steel . . . grades that retain high strength at 2200°F and above or at subzero temperatures.

Let us tell you more about Kennametal and how it has helped others solve problems that may be similar to yours. Write to KENNAMETAL, INC., Dept. CE, Latrobe, Pennsylvania.

... Partners in Progress

†Based on an average daily through-

Dryers.....Five different drum dryers are part of a complete line that includes atmospheric and vacuum types, with chamber, pan, rotary, spray and other models. Catalog 380 is available on roquest. is available on request. 107a \*Blaw-Knox Co.

Dryers.....Standard dryers are available in several types: direct heat, indirect heat and steam tube. No dryer problem is too small or too large for company's engineers. Bulletin D4-B2.

\*Denver Equipment Co.

Dryers, Steam Tube.....Steam tube dryers are fabricated to code requirements, with continuous siphon discharge of condensate independent of speed of rotation of shell. Bulletin 16-D-11. \*Hardinge Co.

Dust Collectors.....Bulletin entitled "Out of the Realm of Dust" shows how company's dust control makes employees more efficient, lengthens machinery life, reduces housekeeping costs. Free. \*Pangborn Corp.

Dust Collectors . . . . Self-cleaning 18" cyclone tube solves problems of dust collection. Greater capacity with less air flow resistance, higher reduced pressure loss. efficiency, reduced pressure loss.
Bul. D-584.
205B \*Dustex Corp.

Dust Collectors.....Line of dust collectors and auxiliary equipment is used to recover all types of industrial dusts in chemical, petroleum, food, metal, plastics industries. Bulletin A-9157. Ducon Co.

Dust Filters . . . . "Industrial Dust Control" describes complete line of dust filters and gives detailed information about dust control systems and how to engineer them. Engineering describes included. drawings included. 202B W. W. Sly Mfg. Co.

Entrainment Separtators . . . . . "Kar-bate" impervious graphite entrain-ment separators are an efficient and economical means of removing entrained liquids from gas streams. Catalog Section S-6900. 91 "National Carbon Co.

ders.....Wet reagent feeders ac-curately meter minute quantities of liquid from O cc. to 2000 cc. per minute. Used in multiples for higher capacity. Easy hand-wheel adjustment. Bul. F6-B9. 178e \*Denver Equipment Co.

Feeders, Airlock . . . . . Booklet P-55,
"How to Select a Rotary Airlock
Feeder", describes airlocks for low
pressure dust control and high pressure pneumatic conveying. Standard, heavy duty, blow-thru.
204B Prater Pulverizer Co.

Fertilizer Equipment . . . . . Condensed catalog contains photos and descriptions of line of equipment for nitrogen solutions and complete liquid fertilizers. Covers tanks, trailer applicators. Catalog 31.

202C General Metals.

Filter Cups.....Porous Tefion filter cups 12 inches high by 5 inches I.D. can be obtained for atomic energy use. They remove particles over 3 microns. Molded in one operation. TD 1334. 93-4i \*U. S. Industrial Chem. Co.

\*Trademark

put of 100-150 tons.

<sup>\*</sup> From advertisement, this issue

Filter Fabrics.....Company offers a free booklet entitled "Filter Fabric Facts" to remind you of the help always available to you through their staff of filter fabric specialists. Send for your free copy.

110 \*Wellington Sears Co.

Filter Media, Felt.....Windsor felts are unique, fiber bonded, non-woven structures engineered to serve as economical and efficient fiber media for industrial processing. Data Sheet No. 18.
212 \*American Felt Co.

Filters.....Fulflo filters provide any desired degree of micro-clarity for all types of industrial fluids. They give true depth filtration, at minimum pressure drop. Request catalog.

51 \*Commercial Filters Corp.

Filters, Disc......Specially designed segments in disc filters use both gravity and vacuum to give a drier filter cake. Drainage is complete, with no blow-back. Request Bulletin FG-B1.

178f \*Denver Equipment Co.

Flotation Equipment . . . . Flotation is the selective separation of particles from each other in a liquid pulp by means of air bubbles. "Sub-A's" give maximum recovery at low cost. Bul. F10-B81. 178g \*Denver Equipment Co.

Mills, Ball.....Steel-head ball mills have five types of discharge trunnions, all-steel construction, low initial cost. Laboratory and pilot plant models also available. Bulletin B2-B13.

\*Denver Equipment Co.

Mixers . . . . . Company designs and builds the complete mixer unit—mixer drive, shafting, impeller and coupling. Six standard models and other special units are available to you. Catalog A-27.

30 \*Phila. Gear Works.

Mixers.....Mix-Mullers to give positive moisture control, intensive blending and controlled dispersion. They can be used to prepare any dry or wetted solid. Send for Bulletin on CPI uses.

109 \*National Engrg. Co.

Mixer . . . . 4 p. bulletin explains, by cross-section view, how mechanical mixer quick mixes any number of dry materials in any proportion. Physical dimensions and capacities of six models included.

203A Buflovak Equipment Div.

Paddle, Stirring.....New type of stirring paddle combines centrifugal force, suction, shearing action, counter whirl. Promotes high flow velocity through entire vessel. Ask for TD 1336.

93-4k \*U.S. Industrial Chem. Co.

Pelleting Equipment . . . . Pellet Ace compresses powders into dense pellets, providing material that is dust free, easy to handle and package, more economical for drying or cooling. Bul. 182.

43b \*Sprout, Waldron & Co.

Processors ..... Turba-Film Mark II
processor provides mechanically
aided heat and mass transfer in
one pass, continuously and rapidly,
for many viscous fluids and slurries.
Catalog 117.
105 \*Rodney Hunt Machine Co.

truly, all-purpose, general service pumps

ADAPTABIF



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Adaptable . . . Versatile . . . Simple . . . Compact . . . Economical. Weinman General Service Unipumps are truly all-purpose, general service pumps.

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THE WEINMAN PUMP CO.

290 SPRUCE ST. COLUMBUS 8, OHIO

**Centrifugal Specialists** 

<sup>\*</sup>From advertisement, this issue





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Now the superlative Mastergauge is available in a wider range of corrosion resistant tubes and sockets than any other pressure gauge.

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remember that tube socket and tip are fused into one piece by the exclusive Marsh "Cono-weld" process. Marsh alone combines the "Conoweld" construction, the copper-clad "Marshalloy" case, the finer Mastergauge move-ment, the Marsh "Recaliment, the Marsh "Recali-brator", the new "Safecase." Ask for data covering your specific needs.

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MARS



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CHICAGO 50. ILLINOIS

Samplers.....Automatic samplers are heavy duty units, with extra rigid track and ball-bearing wheels to assure positive travel and timing of sample cutter. Wet and dry. Bulletin of Parkin Carlotter and dry. Bulletin Carlotter and Date of Parkin Car tin S1-B4. \*Denver Equipment Co.

Spray Drying....Bulletin 560 explains how to obtain a quality product—e.g., nonfat milk, whole milk and dietetic foods—with spray process. Horizontal spray dryer is described and illustrated. Blaw-Knox Co.

Tables, Concentration . . . . . Concentra-tion tables separate materials into bands and handle coarse sands well. Ideal for particles with a similar range of specific gravities. Bul. T1-

\*Denver Equipment Co.

# Pumps, Blowers, Compressors

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Pumps.....General service Unipumps are adaptable, versatile, simple, compact and economical. They op-erate efficiently in any position, on floor or walls. Send for illustrated Bulletin 300. 203 \*Weinman Pump Mfg. Co.

Pumps.....Redesigned line of Hydro-seal sand and dredge type metal pumps for handling abrasive solids over 4-mesh have impellers and shells made of special resistant alloys. Brochure No. 657. 204B Allen-Sherman Hoff Pump Co.

Pumps, Centrifugal.....Company of-fers complete specifications on all Eastern centrifugal pumps in Bul-letin 120-B. They range from ¼ to ¾ H.P. with capacities up to 70 % H.P. G.P.M. 195 \*Eastern Industries Inc.

Pumps, Chemical.....Vertical pump 19,478 pumps molten chemicals; horizontal pump 6043 handles black liquor, caustic, etc., in evap-orator service and transfers fluids under vacuum. Bul. V-387. 171

Pumps, Corrosion Resistant . . . . New 200-D.O. corrosion resistant positive displacement pump is only 17 inches high, has a maximum capacity of 300 G.P.M. Free bulletin is available to you.

157 \*Waukesha Foundry Co.

Pumps, Metering....New McCannameter is a packless pump that provides accurate metering and proportioning over a wide output range. Compact design, continuous flow characteristics. Booklet 302.

151 \*Hills-McCanna Co.

Pumps, Rotary.....Features and op-erating characteristics of Gaulin Twin Lobe rotary positive displace-ment pumps are featured in Bulle-tin TLP-57. Emphasis is placed on unique cosine rotor development. 2046. Manton-Gaulin Manton-Gaulin.

<sup>\*</sup> From advertisement, this issue

Pumps, Rotary ..... Minilab Model
HCT low capacity rotary pump is
designed for corrosive service in lab
and pilot plant. Made of Hastelloy
C with Teflon or carbon impellers,
bearings and Teflon packing.
205A Eco Engineering Co.

nps, Vertical . . . . Vertical pumps handle hydrocarbons, hot and cold water, mild acids, basic and salt solutions. Outstanding net positive suction head characteristics. Bul. \*Peerless Pump Div.

# Services, Processes, Misc.

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Gloves, Protective.....Gloves made of molded rubber and synthetic mate-rials in various weights, sizes, types are described in Bulletin 1310-2. Guide shows resistance of materials common chemicals. 205C Mine Safety Appliances Co.

Laboratory Equipment.....Batch and continuous test models of ball mills, screens, crushers, rod mills, classi-fiers, mixers, pumps, pulverizers, thickeners, feeders, samplers, etc. thickeners, feeders, samplers, etc. Bul. LG3-B10. 178i \*Denver Equipment Co.

Laboratory Service.....Customer service laboratory has an extensive line of small scale and pilot-size equipment for drying, evaporation, extraction, impregnation and crystal-lization. Cat. 381. \*Blaw-Knox Co.

tocopying . . . . How office copying can save and increase efficiency in purchasing, sales, production, ad-ministration, etc. is described in 16 p. illustrated booklet on Verifax copying. Photocopying ... copying. 205D Eastman Kodak Co.

ple Counting Equipment..... Summary of essentials in selecting nuclear equipment for sample Sample nuclear equipment for sample counting emphasizes choice of de-tector, its shielding, sample posi-tioner. Compares cost of all equip-Tracerlab Inc. 205E

Technical Course.....Pfaudler in-structs maintenance and process structs maintenance and process men in the care and repair of glassed steel equipment. They offer a copy of the program describing the course's subject matter.

16-7d \*Pfaudler Co.

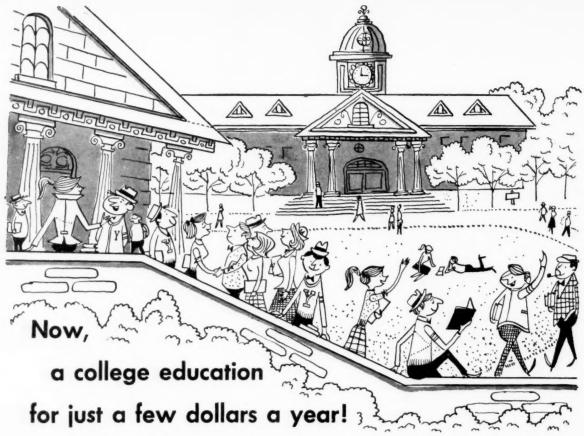
Water Softeners....Bulletin 57-1 on water softeners is latest addition to manufacturer's "Fact-File-Folder" on water conditioning equipment. Lists some of more popular softeners and their specs. 205F H. M. Mueller Corp.

Wood Research.....Highlights of 25 years' service to designing, building, wood producing and using indus-tries are described in Timber Engi-neering Co.'s pictorial anniversary Timber Engineering Co.

· From advertisement, this issue







Some time ago, a man called your name, and you walked across a stage, and were handed a diploma. Were you proud! You were educated. The world was your oyster.

You promised yourself then that you would keep your education alive. That you'd go back and earn that graduate degree. Or brush up at night school, or some summer seminar. But then you met that pretty girl. A few years later — the stork, the new house on Cedar Road . . . everything seemed to happen at once.

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Graduate Engineer with ability to translate basic data, plant operating data, and pilot plant tests into rotary dryer design. Must be capable of assuming full responsibility for thermal design and performance.

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P-7338, Chemical Engineering Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

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Salary in line with ability and experience; advancement by merit; complete benefit program; Company-paid retirement plan.

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# BUTLER MANUFACTURING CO.

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P-7400, Chemical Engineering 520 N. Michigan Ave., Chicago 11, Ill.

#### CLASSIFIED . . .

# EQUIPMENT SEARCHLIGHT

CE's Searchlight spots the big bargains in used, resale and rental equipment. Check this issue's listings—most complete in the field—for items you need now.

► Coverage—National (see index of advertisers in this section for your nearest dealer). Equipment and facilities-used, resale and rental-for the process industries. For sale, wanted, for rent. ► Rates—\$21.75 per inch for all ads except on a contract basis; contract rates on request. An ad-

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► Closing date — April 21st issue closes March 31st, Send all new ads to Chemical Engineering, Classified Adv. Division, P. O. Box 12, New York 36, N. Y.

# BIG SAVINGS IN GUARANTEED EQUIPMENT

DRYERS & KILNS

Buffalo Vac. Drum Dryer 24" x 20".

—Albright Neil 4' x 9' Atoms, Drum Dryer.

ac. Shelf Dryers & Kilns.

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4—Tolhurst 49" Suspended Type Centrifugals.
8—Centrifugals 12", 39", 49", 4, 48" Steel, Copper, Stainless & Rubber lined.
6—Sharples Centrifuges #5 Stainless, Also #6.
3—De Laval Multiple Clariflers #200, 300 & 301.

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KEILED & IANNA 6—Stainless Jack Kettles 300, 100 & 50 gals. I—Dopp 350 gal. C. I. Jack, Vac. Kettle. Devine & Stokes Impreg. Units 30° & 36° dia. Devine 1000 gal. closed jack. Steel Kettle. 30—Stainless, Jack Cettle. 50—Stainless, Alunn. Copper, Glass & Lead Lined Kettle. & Tanks. Also new Stainless.

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Williams 28B, 23 & 22XX Hammer Mills.
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3—Steel 3 Roll Mills 5"x32", 12"x30" & 16"x40".
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U. S. 1½ H.P. Colloid Mill
Eppenbach Staniesa Colloid Mill H.P.

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MIXERS & SCREENS
Day Imperial 75 & 150 gal. Jack. Mixers.
Baker Perkins double arm 50 & 100 gals.
—Read 50 & 100 gal. double arm mixers.
Lancaster 6' dia. vert. Mixer 25 H.P.
Kent 3 H.P. Continuous Dry Mixer.
3—Day 8, 15 & 40 gal. Pony Mixers.
Read 40 and 80 qt. vertical Mixers.
6—Lead—Paste Mixers 50 to 150 gals.
Boblisson 20x 46' Gyro Sifter 3 opening.
Day Jumbe 700 gal. horiz. Mixer.
Day Jumbe 700 gal. horiz. Mixer.
10—Dry Spiral Mixers 50 to 3000 z.
12—Pertable Elec. Agitators 1/4 to 5 H.P.

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Colton 5 T single punch preform machine.
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Bett Conveyors 12", 15" & 20" long.
Anderson & French Oil Expellers.
Gould 75 H.F. Centrivual Pump 250 PSI.
Filling Machines powder, paste & Injud.
I—Howe Mogul Barrell & Bag Packer.
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Soap Machinery for Tollet, Laundry, Chip, Liquid.
Powder Stokes & Buffalo Vac. Pumps.
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Sterling 8-1944

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# WANTED Stainless steel laboratory size SPRAY DRYER

W-7409, Chemical Engineering Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

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6' x 50' Louisville Steam Tube Dryers 30" S. S. Susp. Cent. 10/5HP XP 6' x 9' S. S. 347 Column 21 Tray 7'5" x 24' & 5'2" x 16' Roto-Louvre Dryers x 6' Oliver Precoat Filter, Rubber 750 Gal. Steel Jktd. Reactor 300PSI

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# Phone: Canal 6-5333-4-5-6

NASH HYTOR H-10 VACUUM PUMPS
Direct coupled 150 HP synchronous motor
440 V 60 cy 360 rpm, control panel &
junction box. 4 units available for sale

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Bird 24" x 38" continuous Centrifugal. Sharples Super-D-Hydrators C-20 & C-27. T316 SS and monel.

Copper bubble or tunnel cap Columns: 24", 36" 42", 48", dia., up to 59 plates.

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1070 sq. ft. shell and tube exchangers, T304 SS, ASME 150#.

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Sweetland Filters: #12, #7, #5. Eimco 10'D x 12'F Rotary Vacuum Filters, rubber covered.

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2—Pfaudler 1500 gal. glass lined, jacketed, agitated Kettles, 90= jacket, 50= internal pressure. I-Nooter 1000 gal. nickel-clad, jacketed agitated Reactor. 2—Pfaudler 250 gal. glass lined, jacketed, agitated

-Praudier 200 gai. S.S., jacketed, agitated Re-actor, XP motor. 300 gai. glass lined, jacketed Praudier 500 and 300 gai. glass lined, jacketed 1600 gai. 316 S.S. jacketed, agitated Reactor, 200 internal pressure, 75 °°. 3500 gai. 304 S.S. jacketed, agitated. Wyatt 24" dia. x 42', 304 S.S. Bubble Cap Col-

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1—1220 sq. ft. 304 S.S. tubes, 150 psi.
1—1050 sq. ft. 304 S.S. tubes, 75 psi.
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1—36 sq. ft. 304 S.S. tubes, 150 psi.
1—36 sq. ft. 304 S.S. tubes, 150 psi.
1—315 sq. ft. 316 S.S. tubes, 250 psi.
1—315 sq. ft. 316 S.S. tubes, 200 psi.
20—16, 20, 28, 48 & 68 sq. ft. 316 S.S. tubes.
7—Karbate 2.4.6 sq. ft. tubular.

#### MIXERS

I-Baker Perkins =15USE, all Stainless double arm, jacketed, Vacuum.

-Baker Perkins =15VUMM, 100 gal. jacketed, 100 HP.

I-Baker Perkins =15VUMM, 100 gal. jacketed, sigma blades, Vacuum.

I-Baker Perkins =151M N 100 gal. jacketed, sigma blades, Serkins =151M N 100 gal. jacketed, Sigma blades, Separa Serkins =151M N 100 gal. jacketed on the service of the service o

#### **DRYERS**

I-Bartlett & Snow 6' x 30' Rotary. 3-Link Belt Roto Louvre 5'2" x 20', 6'4" x 24',

7.5" x 25'.

- Devine double door Vacuum Shelf 17 and 28—
59" x 78" shelves.

- Devine single door Vacuum Shelf 20—40" x 43"

Devine Single door Vacuum Shelf 4, and 6—24" x Stokes single door Vacuum Shelf 4, and 6—24" x Stokes single Steam Tube 6" x 50", 6" x 40", 6" x 25" Louisville Steam Tube 6" x 50", 6" x 40", 6" x 25" Buflovak 5" x 12" Atmos. single drum. Devine 4" x 9" Atmos. single drum. P&S Tray Dryer, Steam Heated, 166 sq. ft.

# MISCELLANEOUS

3—25 Ton Freen Refrigerating Units.
7—Stokes DD2, DS3, D3, B2, "R" & "F" Tablet

Presses.
-Nash Vacuum Pumps, H9, H6, H5, L5, T87.

24. — Rotex, Robinson, Tyler Hummer Screens single and multiple deck. — Wilfley 4° Haveg lined Centrifugal Pumps, motor driven under Centrifugal Pumps (Chlorimet, Durimet & Durinen Centrifugal Pumps 1/2" to 3". 10-Rotex. 8-

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Classifiers

# LOEB OFFERINGS

Autoclave: 50 gal. Struthers-Wells, st. st. Centrifugals: 12", 17", 20" and 28". Clarifiers: De Laval and Sharples. Cigrillers: De Lavai and Snarpies. Crystallizers: 500 gal. stain. steel, jacketed. Dryer: Devine 2 x 4' vac. drum, st. steel. Fillers: for liquid, paste, powder. Filrers: Eimco, Oliver, Sweetland, Alsop, Sparkler, Industrial, Sweetland.

Spurkier, Industrial, Sweetland.
Filter Presses: Sperry, Shriver 5" to 35".
Kettles: Stainless steel, with and without agitators.

Filter Presses.

Kettles: Stainless steel, with
agitators.
Dopp 150 gal. dbl. act. agitator.
Mills: Mikro Bantam, 2TH and 24".
Jeffery 30 x 24" type A.
Mixers: Dbl. and Sgl. arm sigma blade.
Dry Powder, various sizes.
Gemao stainless steel, 7½ hp.
Gemao stainless steel, 7½ hp.

14. Muller: Simpson st. st. bowl 39". Pumps: Rotary, gear, centrif., vacuum. Screen: Tyler model 300, 5 hp. Tanks: Stainless steel, various sizes. Vacuum Pan: 42" Harris st. steel.

EQUIPMENT SUPPLY CO.

# SURPLUS EQUIPMENT FOR SALE EXCEPTIONAL BARGAINS

Bowen Experimental Spray Dryer: serial No. BD-120; table model; fan, plain steel driven by 2 H.P. open motor 220/440 V; 3 ph. 60 cy.

American Instrument Hydrogenation Bomb with Booster Pump. Hydrogenation bomb, model 406-01, motor driven.

Steam ejector—3 stage: Graham type; Heliflon (10 x F-18): operating steam 90 psi. Sharples Centrifuge #16:SS Bowls: serial 4662089: type M-47—16-Y—IE-Y. Extractors (liquid/liquid)

- 2 x Boilers, iron 24 in dia x 24 in str. side; hairpin steam coil heater, pressure 20 psi.
- 2 x Extractor shells, iron, 48 in str. side x 24 in dia; 4 x 2 in. nozzles; 1 x 16 in nozzle; 1/4 in. plate construction.
- 1 x Boiler, SS #316; 30 in str. side x 24 in dia; hairpin steam coil-heater pressure 60 psi.

Kettle

1 x 100 gal., iron, 30 in. dia. x 36 in str. side, jacket pressure 20 psi; shell, full vacuum; 2 in. flg. bottom outlet.

Alnor Dew Pointer; type 7000 H Serial 512.
Detrex Degreaser; model 1 DCR-750; size is, no. 14984: equipped with Detrex solvent still for non-flammable chlorinated solvents, model S-60; serial 14985. Electrode steam Boiler; series #L.P. 1/2; serial 1083; max psi 15#, 250V; single phase, 24 amps. Nat. Board #8P151BTESI.

Ceramic crock, #1442, 110 gal. capacity.

Pittsburgh Electrodryer #BAC50; serial #8289; 15 psi; 110V, single phase, 60 cy; connected load 1.5 V.W. For drying hydrogen to 80 dewpoint; 140 cfh.

3 x Beach Russ; no. 15 W; 15 cfm.

U. S. model Ez-2 air cleaner for bottles; serial #242

Flowmaster, model 200; serial 2572

- Hobart, mixer and grinder, model M80, serial #742008.
- 2 x Niagara Printomatic Recorders; model 434, code OY.

4 x Morse Condensate pumps: model 300 M 391. Scott Testing machine, L4 with spring recorder.

- 1 x 5 ton Westinghouse air conditioner, serial 1W-19; style 156025-1B: 5 hp motor; fan, 1/2 hp motor.
- Hydraulic Press; comprised of vertically opposed hydraulic cylinders with a hydraulically actuated feed shuttle operating horizontally across die area between cylinder rams. 11-3/16" clearance between rams with both cylinders retracted; 4-3/4" shut height. Equipped with five J. I. C. solenoid operated control valves and miscellaneous hydraulic fittings.

Cylinders and Valves as Specified Below may be Sold Separately Upper Cylinder—1000 psi, flange mounted on ram end, 10" cylinder dia. with 7" dia. solid ram. Maximum stroke 5-3/16".

Lower Cylinder—1000 psi, flange mounted on ram end, 10" cylinder diameter with 7" diameter ram, ram cored 4½" dia. x 13%" deep. Maximum stroke 1½". Return stroke adjustable by means of hand crank.

VALVES

- 2 Pathon #H4W10C2PS Pathon #H4W1C2S 1 Pathon #H4W6C2PS
- Autoclave: SS #316 10 In. ID X 16 Ft. Jacketed 9 Ft. operating pressure, shell 500 psi @ 350 F Jacket at 125 psi @ 350 F
- 3-Waukeshaw Pumps Toledo Platform Scales Calibrated in Kilos
- 1—American Sterilizer Serial 140990
- -Lambert & Mann Vacuums Pump complete with motor. Type SAMG Size 2
- -Varidrive Speed Reducer #2028828 1200 RPM Type VA
- Reeves Motor Drive Size 1102-D-18 Gear Ratio 27-8-1 Serial MD 80576
- Stokes Vacuum Pump
  No. 149B—Serial Al7396
  Lot A 10570 A 50 CFM 350 RPM
  Milton—Roy Controlled Volume Pump
  Code MD2-81-88-S
  2 Plungers each 1½ Dia
  68 Strokes/Min 4" max stroke 60 g.p.h.
  total delivery 120 g.p.h. 2 HP 3 phase
  gear head motor
  Barnstead Still (In Operation)
  Catalogue SS-100 Serial 43096
  Complete with condensers, controlls,
  valves.
  Glasscote glass lined receiver #7686
  Capacity 500 gal.
  Yale Hoist
  Capacity 1½ ton Model LB 1½ C 17824
- - Capacity 1/2 ton Model LB 1/2 C 17824 Serial W 47672 1 HP 220-440, 3 Ph. 60

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Buflovak Dbl. Drum Dryer; 42"x100". Stokes Rot. Jktd. Vacuum Dryer; 34"x10'. Hersey Gas Fired C. Current Dryer; 5'x26'. Carrier Silica Gel Dehumidifier: 800 CFM.

Baker Perkins Dbl. Arm Mass Mixers to 300 a. B-P Stainless 9 gal. Dbl. Arm Mixer; cover. Brand NEW FALCON Ribbon Mixers, all sizes, now in stock.

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# CHEMICAL PROCESSING EOUIPMENT

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- Baker Perkins Stainless Steel Double Arm Jacketed Mixer, with compression cover, 21/4 gallons
- Entoleter Stainless Steel Continuous Mixer, Type PF
- -Eimco Stainless Steel Rotary Vacuum Filter, 4'x3'.

# **CENTRIFUGES:**

- -DeLaval Type 316 Stainless Steel Multimatic Centrifuge
- AT&M 42" Suspended Type Centrifuge, complete with type 347 Stainless Steel Perforate Basket, plow and curb, with 40/20 HP
- Tolhurst 32" Suspended Type Centrifuge with Imperforate
- Sharples Type 316 Stainless Steel Centrifuges, Model D-2 (New)
- -Merco Stainless Steel Centrifuge, Model B9

#### DRYERS:

- 1-Builovak Vacuum Double Drum Dryer, 6" x 8"
- Buflovak Double Drum Dryer, 42" x 120" Stokes Model 59 DS, Steel Rotary Vacuum Dryer, 5' x 30'
- Louisville Rotary Steam Tube Dryers, 6' x 50', Complete Bartlett & Snow Rotary Dryer, 4'6'' x 36'6''
- Stokes Vacuum Shelf Dryers, 2, 4, 6 and 18 shelves
- 1—Stokes Double Drum Dryer, 5' x 12' 1—Louisville Rotary Steam Tube Dryer, 8' x 45'

- Niagara Steel Filter Model 510-28
- Sweetland #3 Stainless Steel Filter, 70 sq. ft. filtering area
- Oliver Horizontal 3' Pilot Plant Filter, New
- Sweetland #7 Filter with 20 steel leaves (20)
- 10-Sweetland #12 Filters with 72 Stainless Steel leaves

## **AUTOCLAVES, KETTLES & TANKS:**

- -Stainless Steel Jacketed Kettles, 250, 350 and 500 gallon cap.
- Combustion Engineers Steel Jacketed Autoclave, 1600 gallons, with agitator and drive, 150# jacket, 600# int.
- -Hamler Steel Horizontal Pressure Tank, 1750 gals., 350 PSI
- 10-Pfaudler Series R. Glass-lined Jacketed Kettles, 1000 gal. each
- 20—Pfaudler 1000 gallon Vacuum Receivers
- Glascote Glass-lined Jacketed Kettle, 500 gal.

  Blaw Knox Stainless Steel Jacketed Kettle, 1750 gals.

- Nickel 1000 gallon jacketed Kettle -Lee Jacketed Stainless Steel Kettle, 125 gal.



THE GELB GIRL-MARCH 1958

#### MIXERS:

- 1-Patterson Kelly Stainless Steel Double Cone Blender, 5 cu. ft.
- Patterson Stainless Steel Jacketed Double Arm Sigma Blade Mixer, 50 gal.
- Patterson Monel Conical Blender, 4.7 cu. ft.
- Baker Perkins Double Arm Sigma Blade Jacketed Mixers,
- Gedge Gray Stainless Steel Ribbon Blender, 65 cu. ft.
- Banbury Midget Pilot Plant Mixer
- -Robinson Type 316 Stainless Steel Sigma Type Jacketed Heavy
- Duty Mixers, 400 gallon capacity, 60 HP

  -Process Engineers Stainless Steel Jacketed Ribbon Blender, 30 cu. ft.

#### MISCELLANEOUS:

- 2-Williams Hammer Mills Type 316 Stainless Steel, Model AK
- -Type 317 Stainless Steel Heat Exchangers, 892 sq. ft. ea.,
- Karbate 60 sq. ft. Heat Exchangers
- -Combustion Engineers Water Tube Package Boilers, 200 HP. 275 pressure
- Selectro Stainless Steel 3 deck Screen, 3' x 5'
- 30-Struthers Wells Stainless Steel Heat Exchangers, 650 sq. ft.
  - Feinc Stainless Steel Rotary String Filter, 3'x3'
  - Tolhurst Stainless Steel 32" Suspended Type Centrifuge, with perforate basket, complete with motor and plow
  - Leader Stainless Steel Jacketed Horizontal Ribbon Blender, 40 cu. ft.
  - Stainless Steel Vertical Storage Tank, with coils, 3000 gallons.

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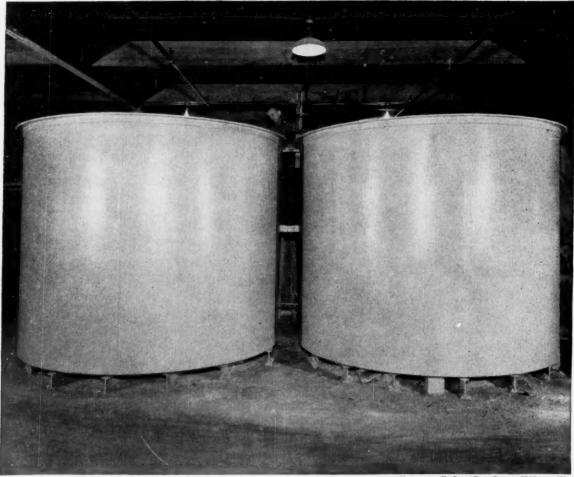
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Capitol Products ...... 25

# **B.F.Goodrich report:**



# No holes, no leaks, no repairsliquid alum stored safely in rubber

B. F. Goodrich improvements in rubber brought extra savings

Problem: This paper manufacturer wanted to cut costs by switching from powdered to liquid alum in their pulp mixture. But getting a tank to hold this corrosive solution was a problem. Wood tanks shrink, often leak. Leadlined tanks require frequent repairs.

What was done: B.F. Goodrich engineers recommended Triflex rubberlining for the two 5,000-gallon steel storage tanks. This lining is not one layer of rubber, but three—hard rubber for maximum corrosion resistance sandwiched between soft rubber for added protection.

Savings: Installed over 17 years ago, the B.F. Goodrich rubber-lined tanks pictured here are still in excellent condition, have needed no repairs on either the lining or the metal. The paper manufacturer feels that with proper care these tanks will last years more. Other tanks and pipe in the system are also B.F. Goodrich rubber-lined.

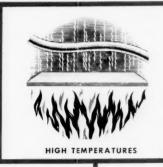
Why specify B. F. Goodrich: In the past 18 years, we have lined hundreds of tanks for alum service, as well as more than 75 railroad tank cars, several tank trucks, and thousands of pieces of pipe and fittings. While the

initial cost of B.F.Goodrich rubberlining is somewhat higher than wood or lead-lined tanks, the rubber-lined tanks do not leak, require little or no maintenance, and are, therefore, much more economical in the long run.

For more information, write B.F. Goodrich Industrial Products Co., Tuscaloosa. Alabama, or Dept. M-302, Akron 18, O.



# If your HOSE LINES must cope with these conditions...





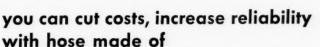


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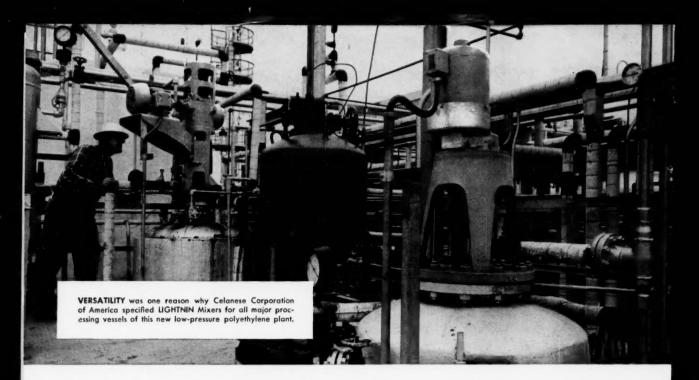
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TEFLON is Du Pont's registered trademark for its fluorocarbon resins, including the TFE (tetrafluoroethylene) resins discussed here.



# Why Celanese chose these mixers for low-pressure polyethylene

How can mechanical mixers help you give the touch of success to an important new process?

Celanese Corporation of America faced this question when its Plastics Division designed a plant to produce 100,000 lbs./day of Fortiflex® low-pressure polyethylene.

#### **Needed: special answers**

"We looked for a mixer supplier who could provide special features required by our process," says Lonnie C. Cunningham, chief engineer at the new Celanese plant, Pasadena, Texas. "Mixco engineers came up with a design that solves these mixing problems for us:

"1. The mixers had to be versatile, since they must suspend solids in liquids over a wide range of operating temperatures. Mixco's experience in our field and similar ones gave us confidence that their design would

stand up in actual performance.

# "No stoppage"

"2. Efficiency of the mixers means much to us, because any stoppage in our continuous process may cause troublesome settling and hardening of material in the tanks. The durable construction of LIGHTNIN Mixers is important in maintaining uninterrupted flow.

"3. Another factor in keeping this process onstream continuously is the LIGHTNIN mechanical seal on some of our pressure units. This seal prevents leakage, and requires practically no maintenance. When necessary, we can change the seal quickly without dismantling the mixer, without loss of product and without pulling specially skilled men off other jobs.

"4. Finally, MIXCO's price was competitive—even though their bid was not the lowest."

# Getting the edge

You can give your new process economic advantages like these by calling in MIXCO at an early stage.

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